VISIT…

SECTION 9

LOCKING & CLAMPING

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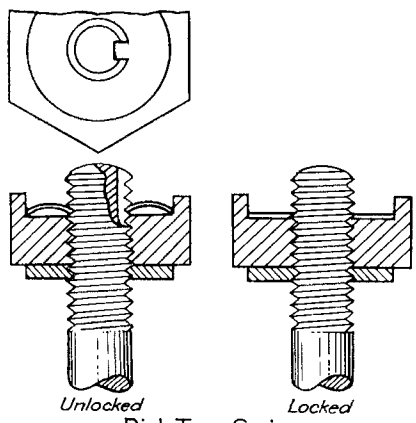
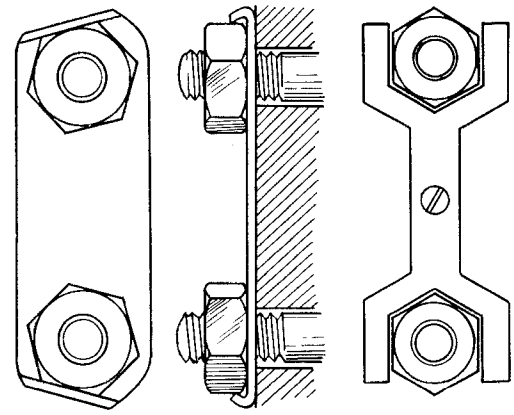
Various Methods of Locking Threaded Members

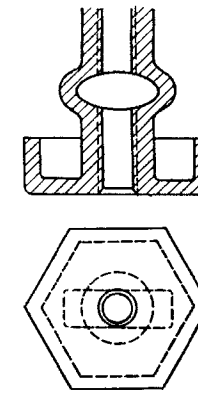
Locking devises can generally be classified as either form or jam locking. Form locking units utilize mechanical interference or parts whereas the jam type depends on friction developed between the threaded elements. Thus their performance is a function of the torque required to tighten them. Both types are illustrated below.



Disk Type Spring



Double Formed Elements



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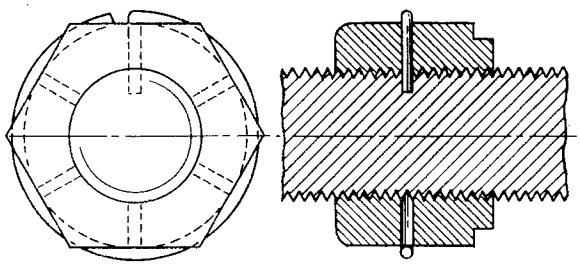
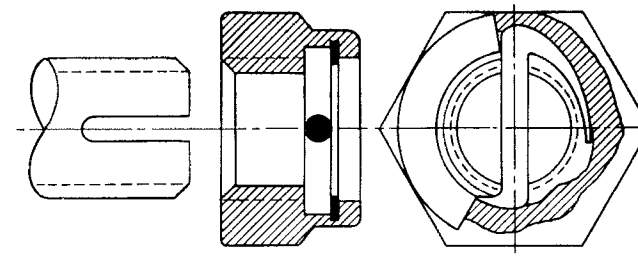
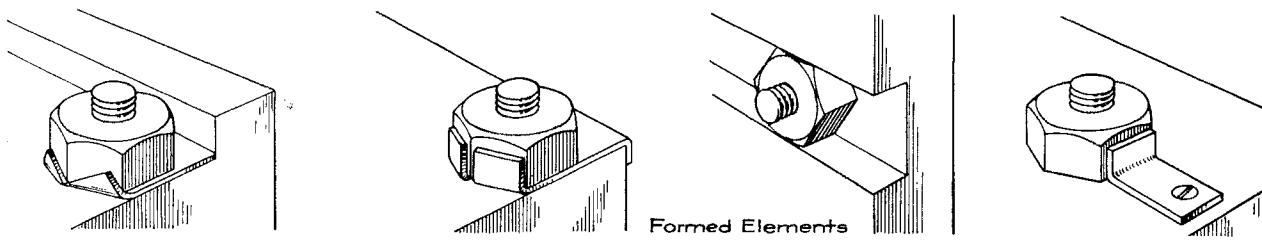


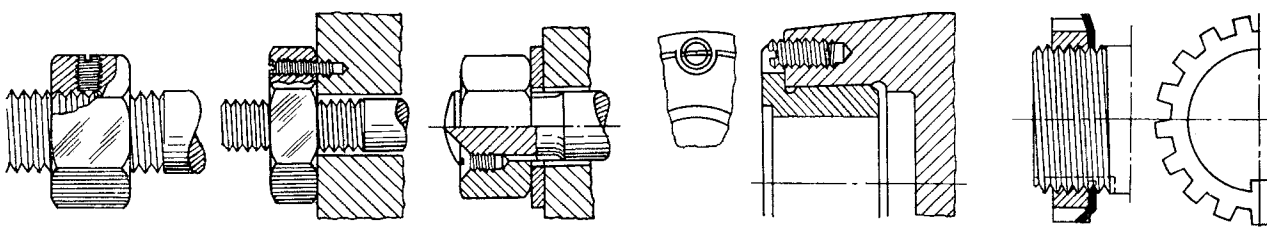
Spring Clip

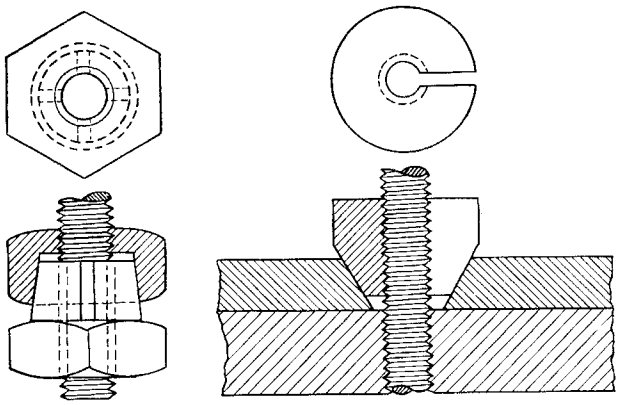


Ratchet Type Nut

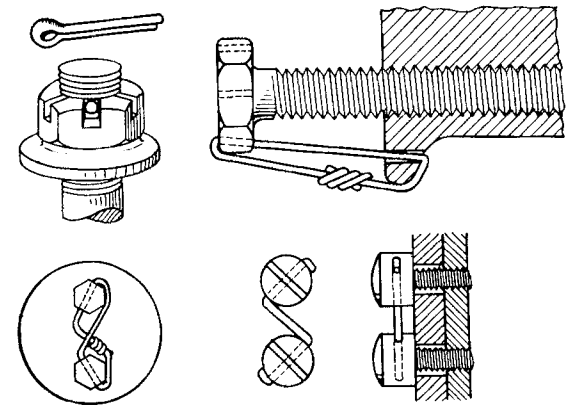


Formed Elements

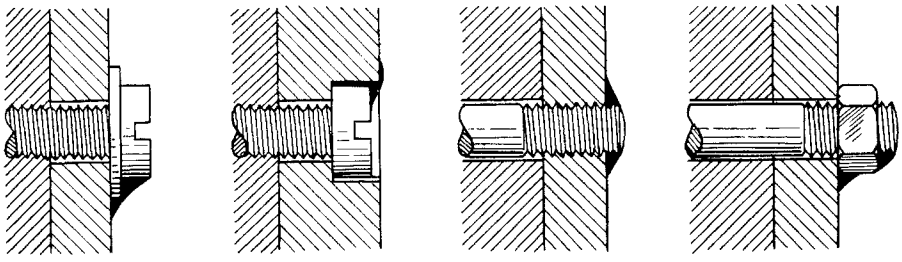




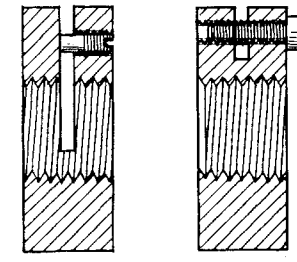
Wedge Action



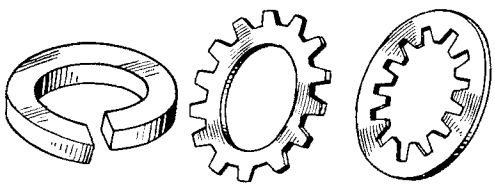
Cotters and Safety Wire



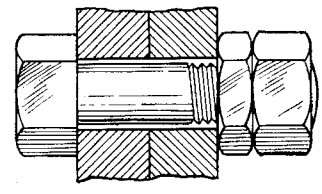
Cement or Solder



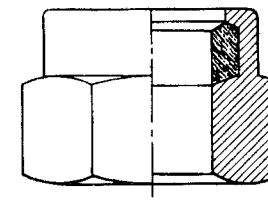
Split Nuts



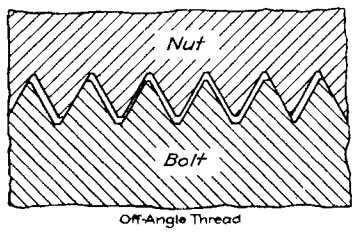
Spring Lock Washers



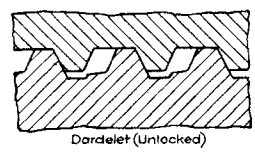
Jam Nuts



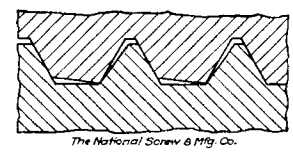
Fiber Inserts



Off-Angle Thread

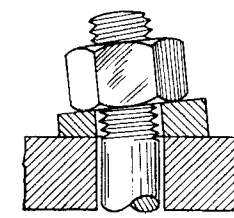


Dardelet (Unlocked)



The National Screw & Mfg. Co.
Lock-Thred

Self-Locking Threads



Tapered Washer

Locking-Type Indexing Fingers

These fingers are required in jigs and fixtures, dividing heads, chucks and dial-feed tables to hold parts securely but temporarily in precise relationship.

Federico Strasser

In any indexing device, there are at least three basic parts: a plunger (key, gage, male or movable part), a bushing (female or stationary hole) and a guide for the male part. In the majority of cases, there is also a spring and sometimes also a housing (body).

The actual design of an indexing device varies enormously from one application to the next, and is influenced by several factors—accuracy, production rate and function.

Classification

The basic form of the indexing gage depends primarily upon the kind of immobilization required. Thus, there are three main groups:

1. Locking. The indexing finger must be made inactive positively when the movable member must pass to the next position

2. Automatic bi-directional. The index finger is retracted (lifted) by itself when a certain pre-established load is applied

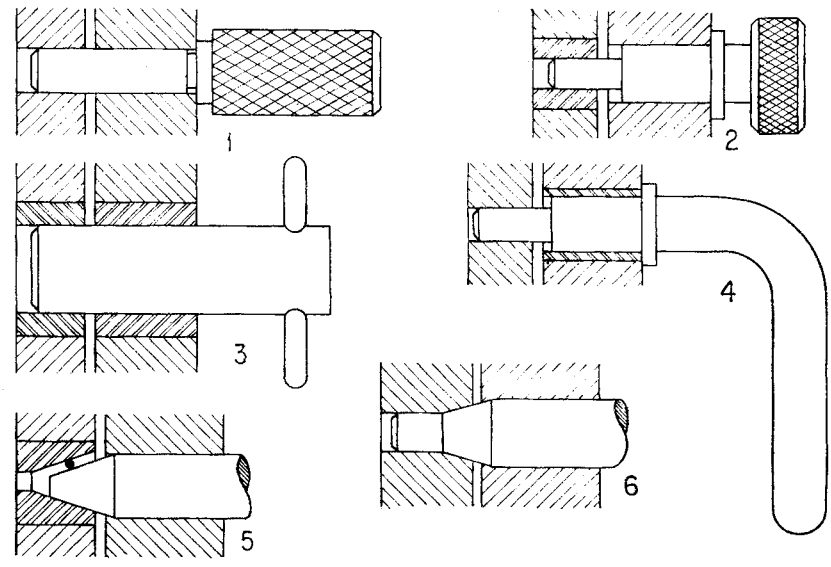
3. Automatic uni-directional. The same arrangement as in (2) but with the limitation that the mechanism-component may be moved only in one direction (it is locked in the opposite direction)

The shape of the indexing finger may be (in increasing order of accuracy):

1. Steel balls
2. Cylindrical plungers with:
   - semi-spherical point
   - 90° degree taper point
   - cylindrical point
   - tapered point (about 10-20°)

For flat indexing gages, either parallel or tapered points are used, with the tapered design preferred.

Removable indexing keys



Indexing fingers are usually made from case-hardened steel, and the aligning surfaces must be ground after heat-treatment.

Design principles for numerous indexing devices are given.

Removable indexing keys

These keys offer the advantage of low tooling costs but are slow in use. First, they must be inserted manually before the machining operation. After the operation is completed, the keys must be withdrawn, the work moved to the next station and keys re-inserted.

The simplest design consists of a round plug, provided with a handle (preferably knurled). The cylindrical part is a slip fit in reamed holes in the stationary and the movable member, Fig. 1.

When the two members are not of the same diameter (Fig. 2), the key is stepped

If the mechanism members to be aligned are comparatively soft, it is good practice to use a hardened and ground steel bushing for guiding the indexing gage, increasing accuracy and life. The bushing may be used in either of the toolmembers (Figs. 2 and 4) or in both of them (Fig. 3), according to conditions.

Indexing plungers over 1 in. dia should be hollow, Fig. 3. In this case the handle is a pin put through the head of the gage. Another design consists of bending the protruding part of the gage, (Fig. 4), to 90°, to make a handle. This design is preferred in case of small diameters.

Misalignment

Although cylindrical holes are commonly used for aligning purposes, sometimes toolmakers prefer tapered holes and gages. This

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design is somewhat objectionable, because any dirt or foreign matter on the gaging surfaces will change the accuracy of alignment, Fig. 5.

The best solution of this problem, but expensive, is a combination of cylindrical and tapered gage ends. In this case, the maximal error (if any) may be only the allowance between the cylindrical hole diameter and the diameter of the cylindrical gage-end, Fig. 6.

Non-removable indexing fingers

These non-removable indexing fingers are preferred for high production tools. In their simplest form the plungers are actuated by a compression spring. For release the plunger is usually pulled out of its seat by means of a suitable handle, which may have any reasonable form, Fig. 7.

If the tool member is thin or soft, the plunger-housing is made as a separate item and a press fit, Fig. 8.

Fig. 9 shows a round indexing gage with a rectangular indexing point. In this case, the shaft must be guided, (prevented from turning radially) while longitudinal movement is effected freely. Therefore, a retaining pin operates in a slot in the housing.

The same indexing task is solved with a flat index gage, Fig. 10. Here a slide is moved in and out by means of a handle.

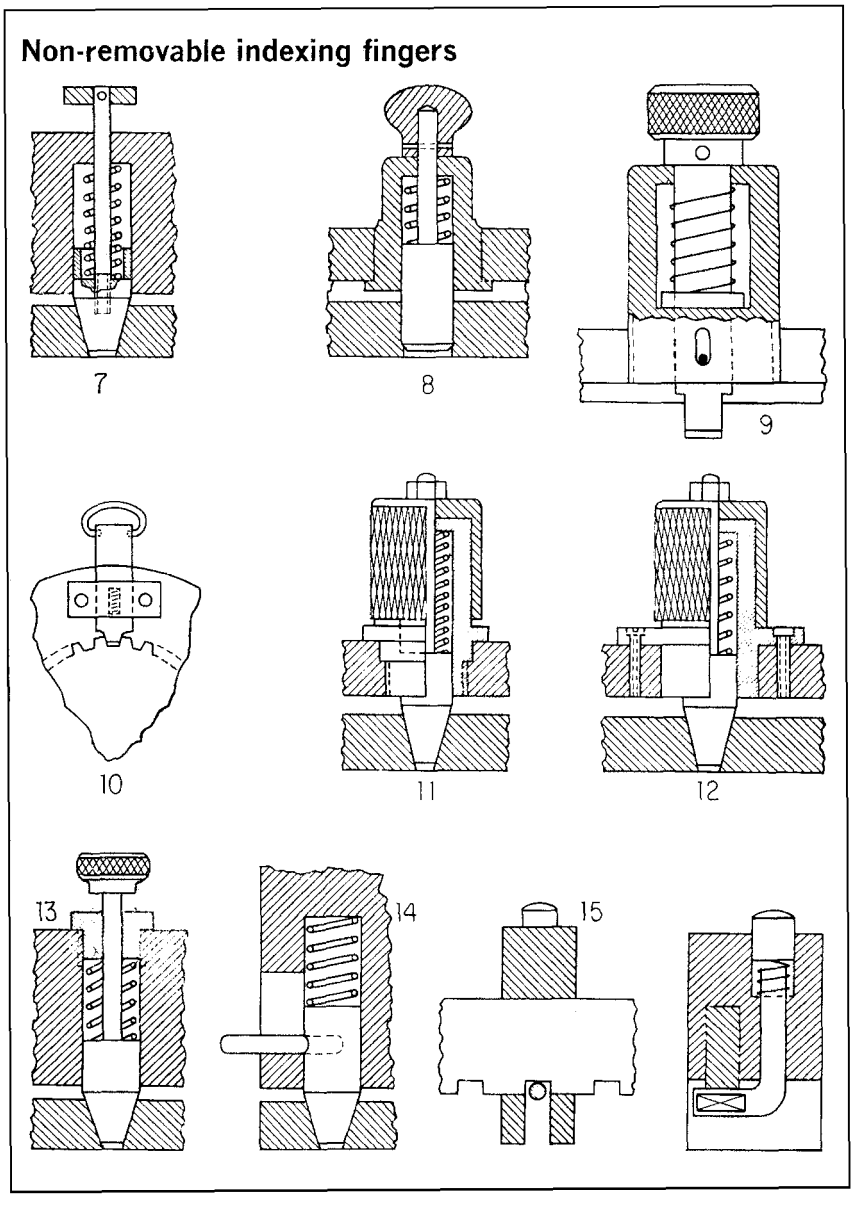
In the case of movable fixtures (those mounted on lathe faceplates) it is necessary to avoid accidents. For such cases the handle is made in the form of a sleeve (Fig. 11). This design offers another advantage: If the indexing point is too tight in its seat, the gage must be loosened before it can be pulled out. This separation is obviously easier to effect with a large knurled handle bushing than with a mere knob. Furthermore, mounting of the housing is made by means of a threaded portion; however, alignment is insured by means of the shoulder.

In another case (Fig. 12) the housing has a large flange, which is screwed to the body.

The plunger is not always mounted on the interior of the mechanism. If it is mounted from the outside, a threaded, knurled bushing holds the plunger in place. See Fig. 13. Now, the index finger may be removed without dismantling other tool members.

If the index finger is mounted in a part that is too large for axial actuation, the motion may be effected by means of lateral pins (Fig. 14).

The plunger is not always pulled out of the tool-member for making the indexing inactive; sometimes it is pushed in, Fig. 15 Here the bent gage is guided.



Some indexing fingers must be actuated indirectly; others require a rest position so that the operator need not hold onto them. Here are 14 designs.

Federico Strasser

Removable and non-removable indexing fingers (**AM**—Nov 21, '66, p139) are commonly actuated directly: that is, co-axially with the indexing point. But there are several designs of fingers which are pivoted and indirectly actuated. In such cases the spring may not be co-axial with the indexing plunger. Then, the spring will be located outside of the device, especially when the finger is not round. Here are several examples:

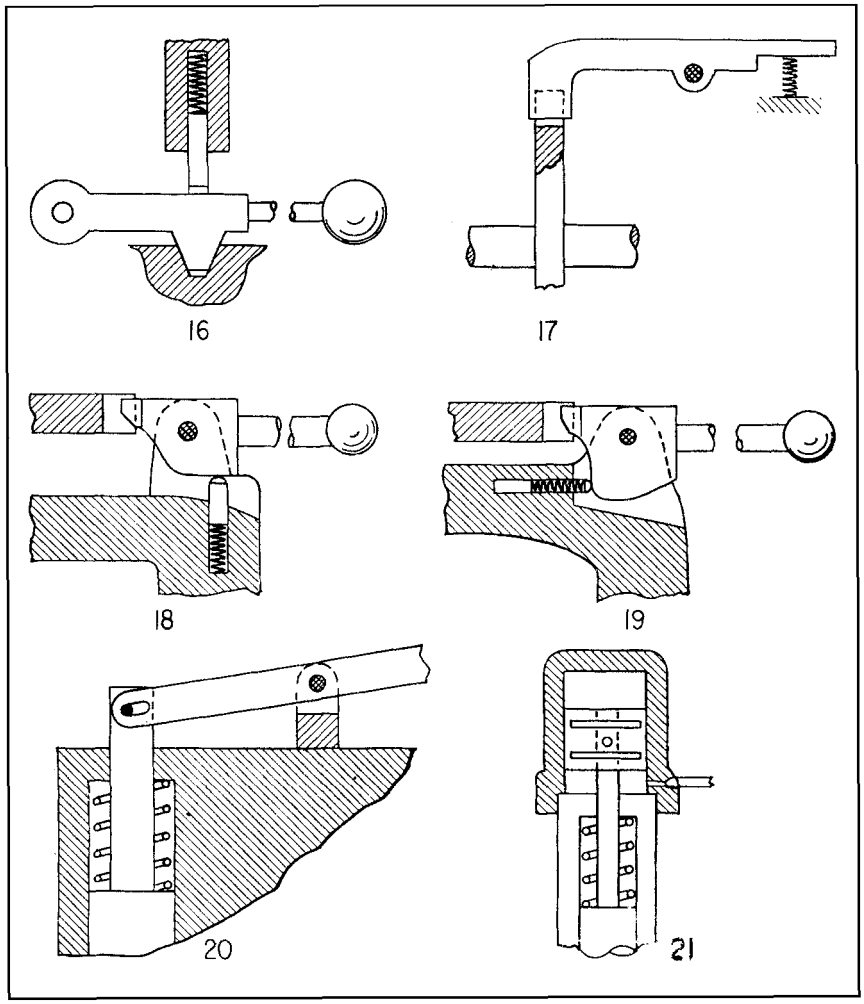
In Fig. 16, the indexing finger consists of a tapered detent on a ball-handled lever. Normally the detent lies in the part to be indexed, being held there by a spring- backed pin. When the lever is pulled up, the mechanism can be indexed.

In the remaining designs, Fig. 17 to 21, the actuating lever is pushed manually or hydraulically to retract the index finger.

To keep out of trouble in such applications, try to foresee potential sources of erratic behavior. For example, in both Figs. 16 and 17, the tool engineer will specify an arc-like pivoting movement of the indexing point to avoid impairing the alignment.

Sometimes the actuating lever is pushed instead of pulled, as in Figs. 18 and 19. Or indirect action may be secured by a handle-operated plunger that is backed by a spring, Fig. 20. When the handle is pushed down, the detent will be lifted out of engagement with the part to be indexed, and when the handle is released the spring will hold the detent in the next notch.

Remote or automatic control can be achieved by hydraulic oil or compressed air. The fluid enters a cylinder and pushes upward a piston connected through a stuffing box to the plunger. When the fluid is released, the spring depresses the plunger, as shown in Fig. 21.



Indexing fingers with rests

So far, the indexing fingers must be held out of engagement by the operator. Sometimes, this is inconvenient or tiring. Therefore a mechanical means of disengaging the finger may be required. There are many ways to accomplish this. Eight examples are shown on page 297.

A very common method is to mill a slot in housing for the finger and drive a pin into a blind hole drilled in the plunger shaft. The

pin ordinarily lies in the slot. When the indexing finger is to be made inactive, the knob is pulled out, rotated say 90°, and let go. Now the pin rests on the top of the housing and the plunger can't engage the indexing notch, Fig. 22.

Two other ways of accomplishing the same objective are shown in Fig. 23 and 24. Here the pin engages an appropriate hole drilled to the proper depth

A bayonet lock is always an easy device to use and it's positive. The sleeve handle, Fig. 25, has the bayonet slot cut in it, and a pin is fitted to the housing. This type of finger is engaged or disengaged with a twist of the wrist.

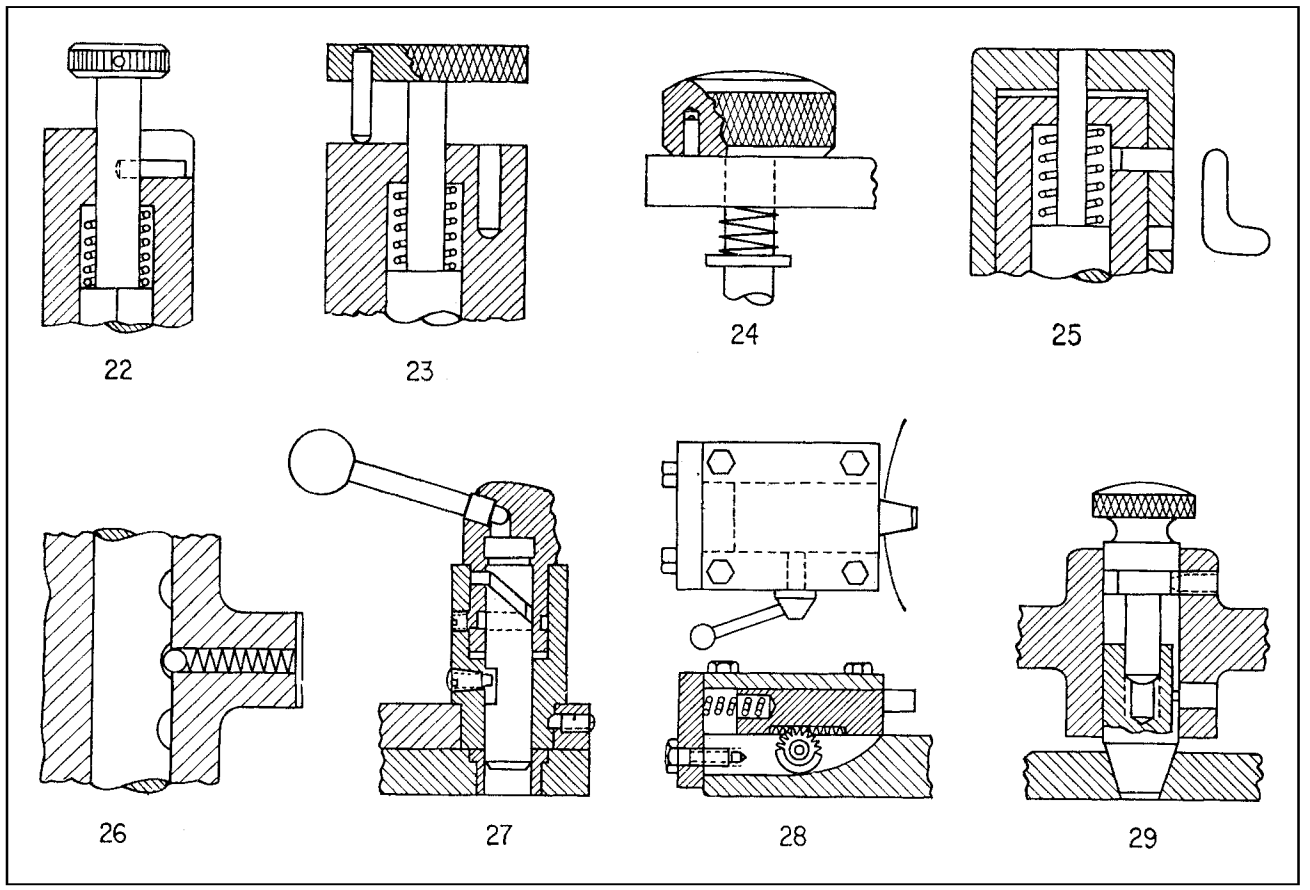
Safe locking of the index finger can be obtained by engaging a spring-backed steel ball into a spherical or notched recess. This design, Fig. 26, requires little effort.

A modification of the wedge idea is the use of a pin in a fast-helix groove. The plunger is prevented from turning, Fig. 27, by a setscrew.

In many cases, a simple eccentric cam (not shown) will lock and unlock the plunger. When a cam can't be placed on the housing head, use a "cam" that acts laterally. In this case a pin in the end of a shaft engages a slot in the plunger and lifts or lowers the latter as the actuating handle is moved.

Racks are a good means for operating heavy plungers. The rack can be cut directly into the plunger body, Fig. 28, while the pinion is operated by the handle.

Our last design, Fig. 29, works without the aid of a spring. In this case the plunger is guided and it is raised or lowered by the knob and screw. The screw is retained in the housing by a pin engaging a circumferential slot.



Eight indexing fingers with rest positions: 22—Pin in slot; 23—Pin enters hole in housing; 24—Pin enters knob; 25—Sleeve with bayonet lock; 26—Ball engages recess; 27—Pin in helical groove; 28—Rack-actuated slide and 29—Screw-operated finger

Retaining and Locking Detents

Many forms of detents are used for positioning gears, levers, belts, covers and similar parts. Most of these embody some form of spring in varying degrees of tension, the working end of the detent being hardened to prevent wear.

Adam Fredericks

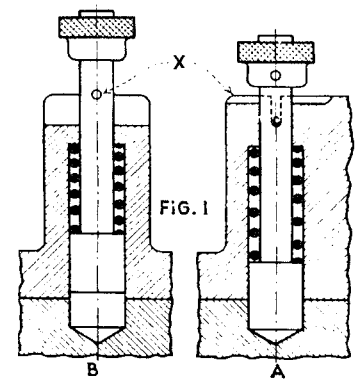


Fig. 1—Driving plunger, shown in engagement at *A* is pulled out, and given a 90-deg. turn, pin *X* slipping into the shallow groove as shown at *B*, thus disengaging both members.

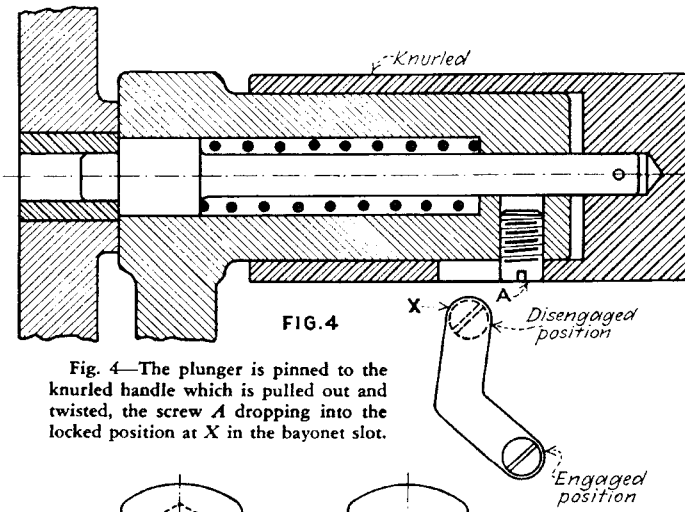


Fig. 4—The plunger is pinned to the knurled handle which is pulled out and twisted, the screw *A* dropping into the locked position at *X* in the bayonet slot.

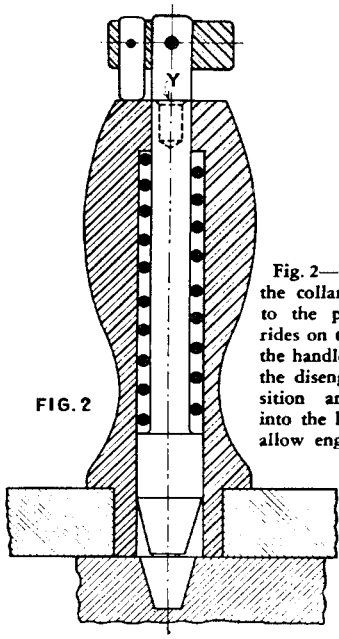


Fig. 2—The pin in the collar attached to the plunger rides on the end of the handle when in the disengaged position and drops into the hole *Y* to allow engagement.

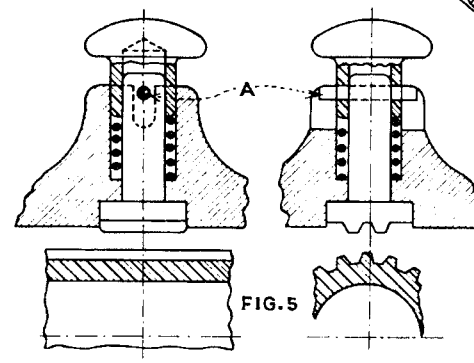


Fig. 5—In this design, the pin *A* engaging in the slot prevents the plunger from turning. This detent is used as a temporary gear lock which is engaged for loosening a drawback rod through the gear.

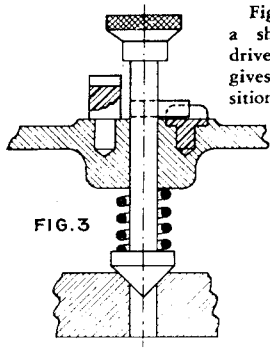
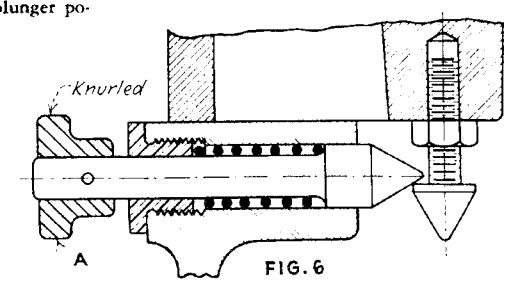


Fig. 3—A long and a short slotted pin driven into the casting gives two plunger positions.

Fig. 6—An adjustable gear case cover lock. Pushing the door shut, it is automatically latched, while pulling out the knurled knob *A* disengages the latch.



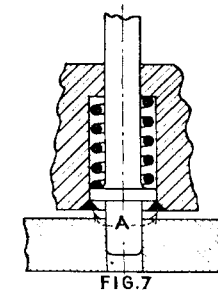


Fig. 7—In this design the plunger is retained by staking or spinning over the hole at *A*.

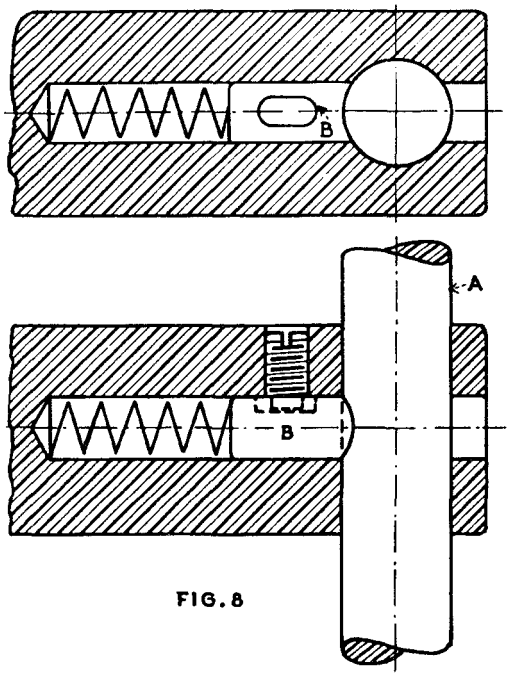


FIG. 8

Fig. 8—End of the plunger *B* bearing against the hand lever *A* is concaved and prevented from turning by the dog point setscrew engaging the splined slot. Friction is the only thing that holds the adjustable hand lever *A* in position.

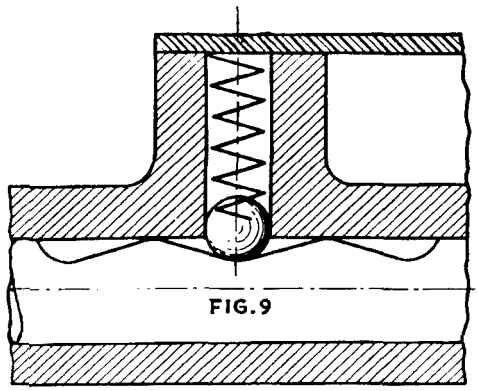


FIG. 9

Fig. 9—A spring-backed steel ball makes a cheap but efficient detent, the grooves in the rod having a long, easy riding angle. For economy, rejected or undersized balls can be purchased from manufacturers.

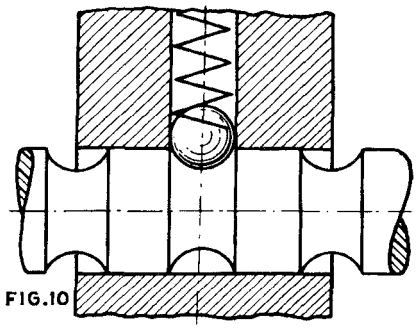


FIG. 10

Fig. 10—Another form in which the grooves are cut all around the rod, which is then free to turn to any position.

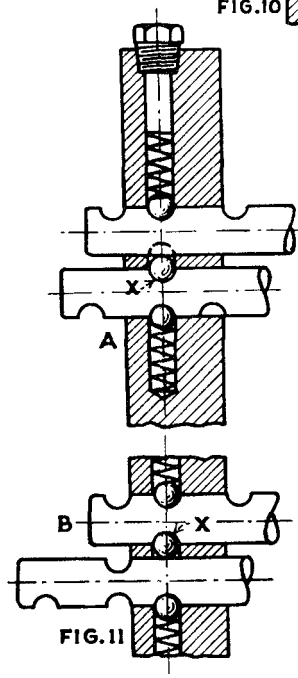


FIG. 11

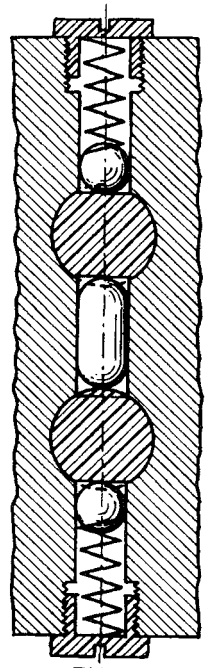


FIG. 12

Figs. 11 and 12—Above is shown a double-locking device for gear shift yoke rods. At *A* the neutral position is shown with ball *X* free in the hole. At *B* the lower rod is shifted, forcing ball *X* upwards, retaining the upper rod in a neutral position. The lower rod must also be in neutral position before the upper rod can be moved. To the right is shown a similar design wherein a rod with hemispherical ends is used in place of ball *X*.

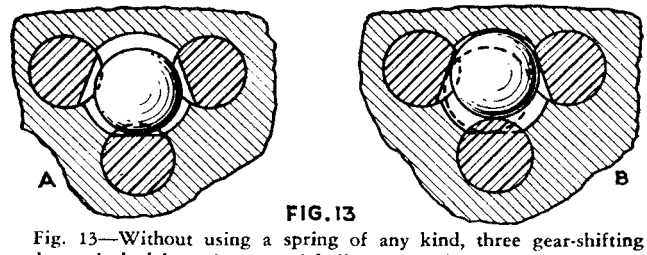


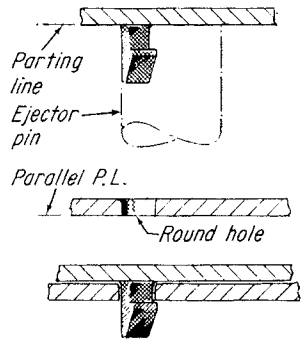
FIG. 13

Fig. 13—Without using a spring of any kind, three gear-shifting rods are locked by a large steel ball. At *A*, the neutral position is shown. At *B*, the lower rod has been shifted, forcing the ball upwards, thereby locking the other two rods. The dashed circle shows the position of the ball when the right-hand rod has been shifted.

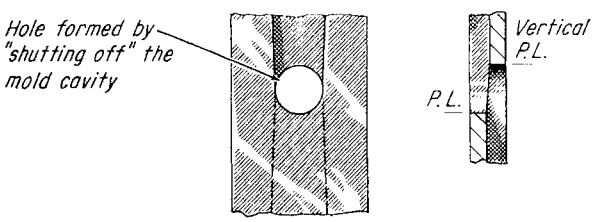
Snap Fasteners for Polyethylene

It's difficult to cement polyethylene parts together, so eliminate extra cost of separate fasteners with these snap-together designs.

Edger Burns

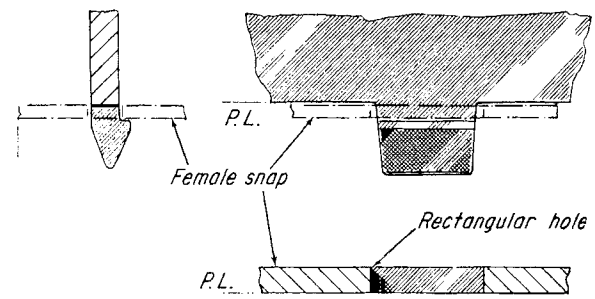


(a) Cored hole

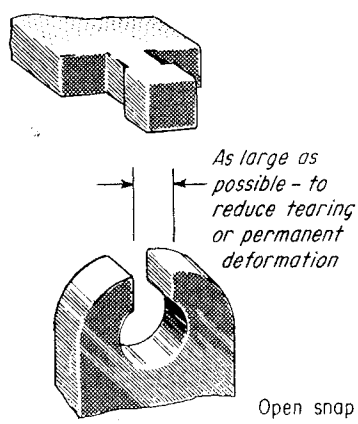


(b) "Shut-off" hole for female snap for different P.L.

1 **EJECTOR-PIN** of mold is cut to shape of snap. Ejected with the pin, the part is slid off the pin by the operator.

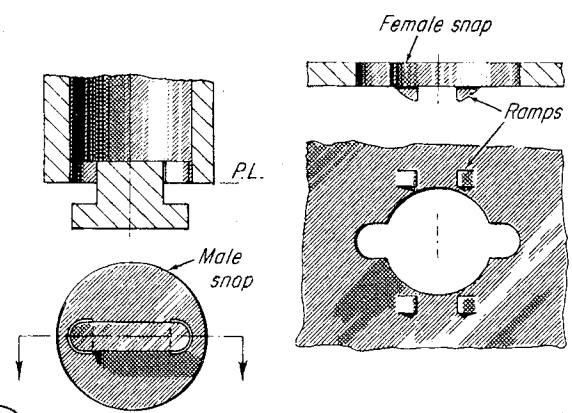


2 **WALL-END SNAP** is easier to remove from the mold than the ejector-pin snap. The best length for this snap is ¼ to ½ in.

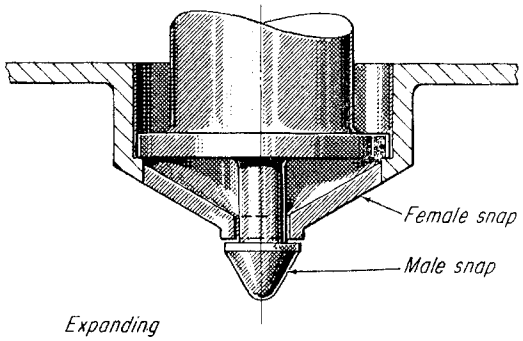


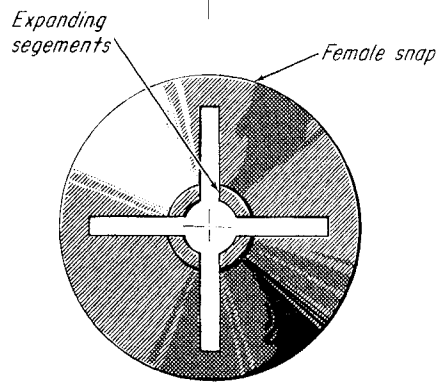
Open snap

5 **OPEN SNAP** relies on an undercut in the mold and on the ability of the polyethylene to deform and then spring back on ejection.

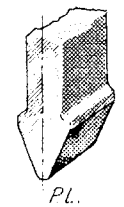


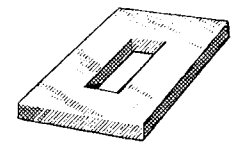
6 **T SNAP** locks with a 90-deg turn. To prevent this snap from working loose, four small ramps are added to the female part.

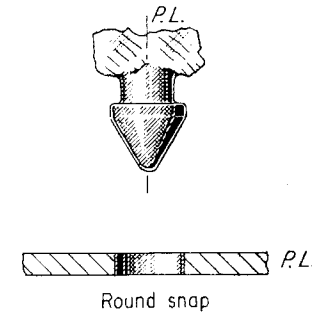




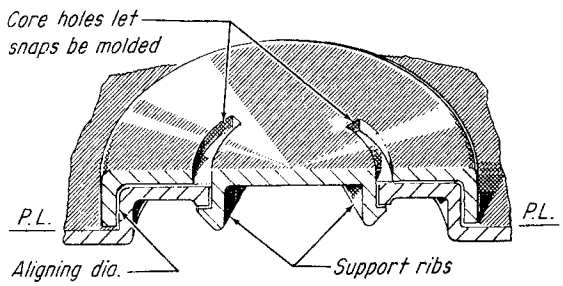
3 **SEGMENTED WALL** of female snap allows a large-headed male snap to enter easily. The snap can not be pulled apart with light loads.

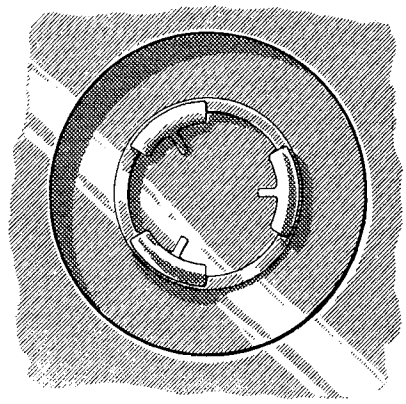



Spear snap

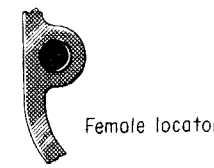


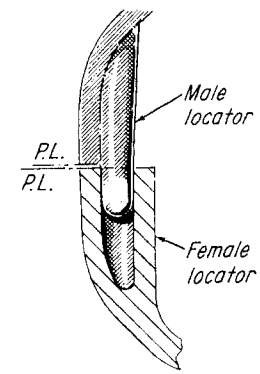
4 **SPEAR AND ROUND** snaps are similar in design to the wall-end snap, but are ideal for assembling small parts to larger ones.





7 **ROTATING** parts can be snapped securely together with three (shown) or two snaps. Mostly for linear polyethylene, it's strong.


Female locator

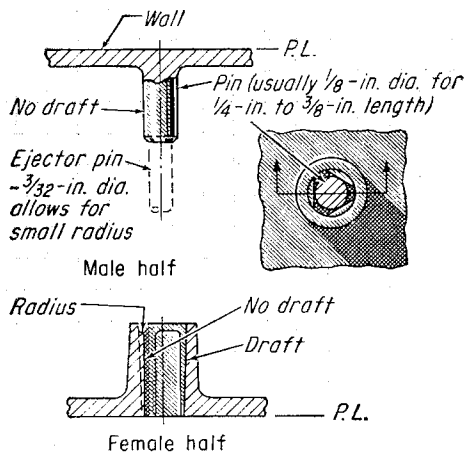


8 **LOCATORS** are not really snaps, but align parts for subsequent eyeleting or riveting or in conjunction with other snaps.

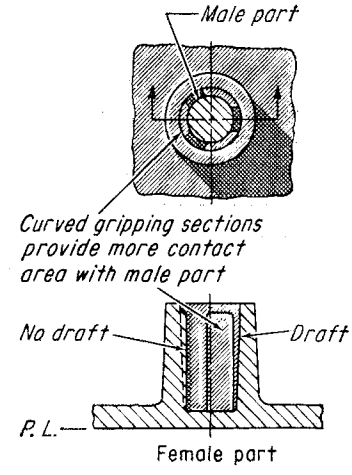
Snap Fasteners for Polystyrene

Here's a low-cost way to join injection-molded polystyrene parts without the use of separate fasteners or solvents.

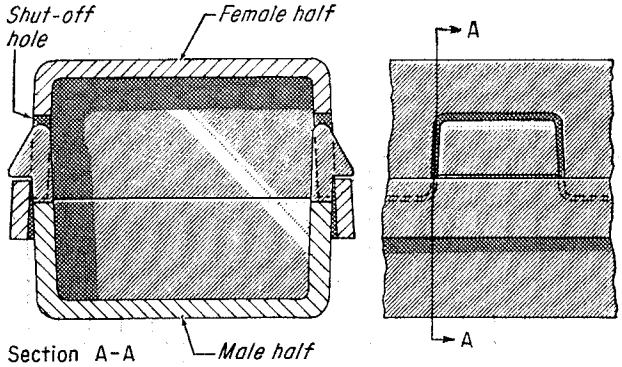
Edger Burns



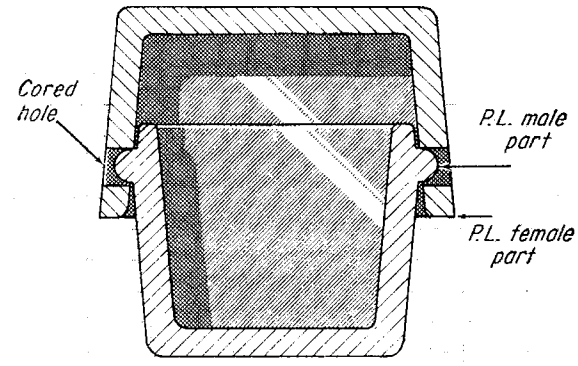
1 **TRIANGULAR SNAPS** actually depend upon friction, but are strong and easy to assemble. Space several around the parts to be joined. Grip can also be adjusted to suit.



2 **CEMENTING SNAP** will allow solvent cementing between the male and female members if required, although the snap will hold well without cement. Usually two or more such snaps are positioned around the parts to be joined. Male part is virtually the same as for the triangular snap. Blind, cored hole requires no shutoff.

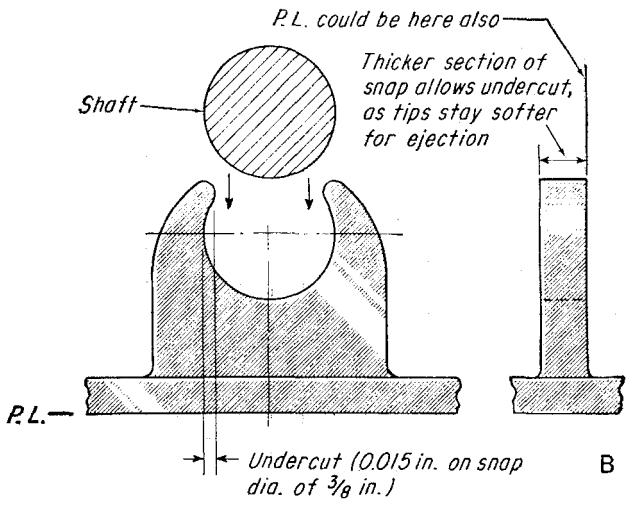


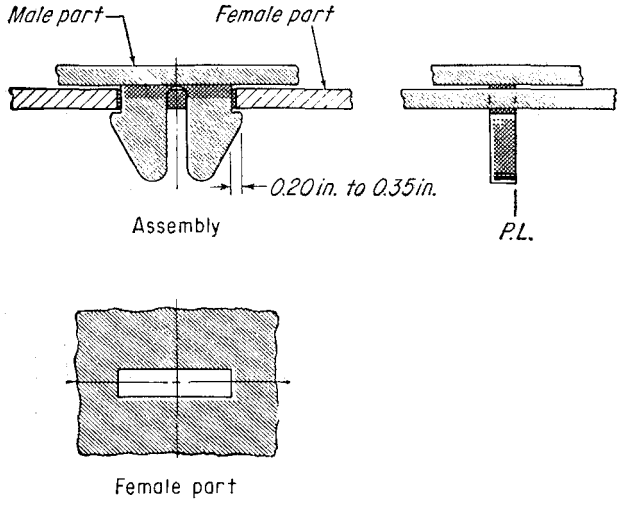
5 **BOX SNAP** requires a mold shutoff in the female half, large enough to accommodate the male part, which slips behind a shoulder and locks, as shown in the diagram.



6 **DETENT SNAPS** are ideal whenever a snap has to be frequently undone, and where a tight hold is not required. The detent itself can be a hemispherical bump, or a more elongated shape.

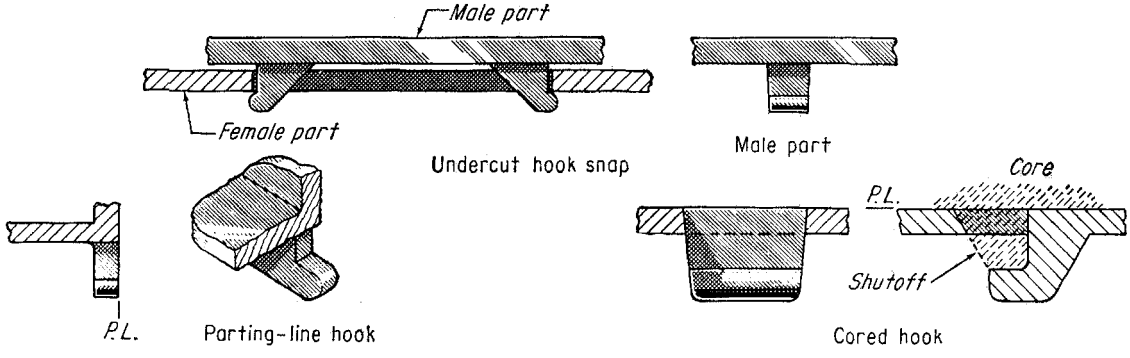
NOTE: *In the following illustrations, the parting line is marked "P.L." It is important in deciding which snap to use and how it should be molded.*


P.L. could be here also
Thicker section of snap allows undercut, as tips stay softer for ejection
Shaft
P.L.
Undercut (0.015 in. on snap dia. of 3/8 in.)
B



3 **OPEN SNAPS** have undercuts of about 0.015 in. on a total snap dia of 3/8 in. Despite small undercuts, stiff polystyrene gives good grip. This snap is not suitable for the regular nonimpact polystyrene. If the parting line can be arranged to lie in the other plane, as shown in B, ejection from the mold would be trouble free, thus avoiding excessive scrap.

4 **PRONG SNAPS** are ideal for snapping small parts onto a larger assembly. The male member is usually on the small part. Slot length in the female part must be designed for maximum holding power, without cracking the prongs on the male member.



7 **HOOK SNAPS.** *Undercut hook* snap relies on an undercut in the mold. To prevent polystyrene breakage on ejection from the mold, make the hooks thicker than the other parts – they then retain more heat, stay softer. Since large undercuts cannot be made this way, however, this snap loosens quite easily.

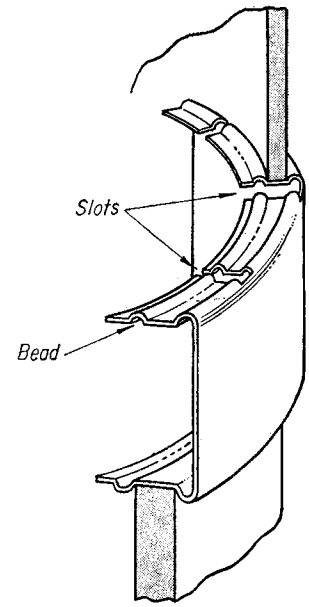
Parting-line hook is much simpler to apply and is easier to design. Choose this snap whenever the parting line can be arranged to be in the plane shown on the drawing. It can be almost any strength and shape desired, and is simple to cut into the mold.

Cored hook requires a core to come down from the other half of the mold, which then produces the inside of the snap. This will leave a hole in the wall to which the hook is attached. Three shutoff surfaces are also required in the mold construction.

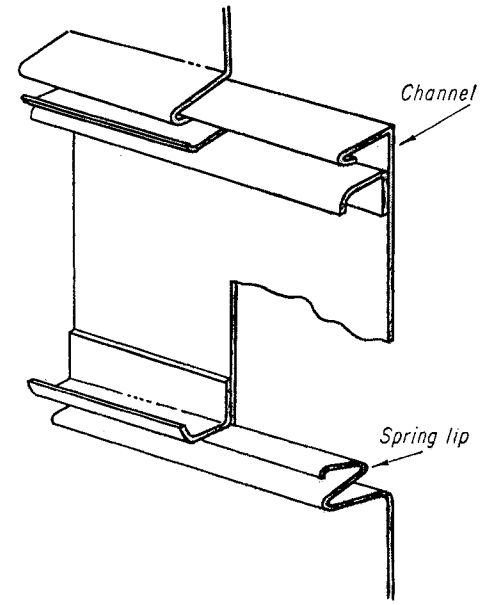
Snap-in Access Panels

These doors show in hinges or handles, need only finger holes or prying lips for positioning.

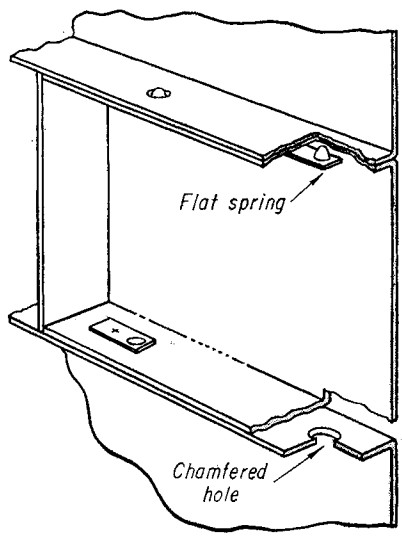
Frank Williams Wood JR



1



2

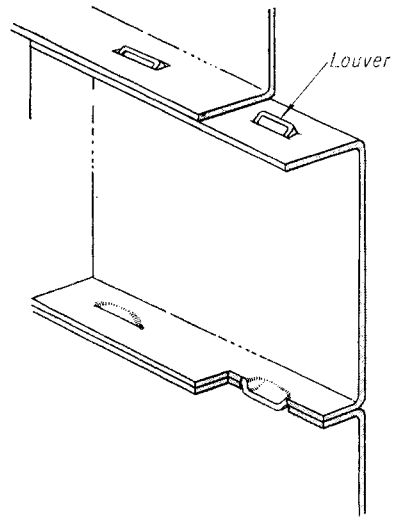


3

1..**BEADED FLANGE** requires panel made of sheetmetal thin enough to flex. Slots are necessary only for curved panels.

2..**DUSTPROOF SEAL** of spring lip is compressed in channel. Should not be used where vibration might loosen it.

3..**FLAT SPRING** holds half-ball or dimple in hole in panel. Chamfer on holes makes action easier.



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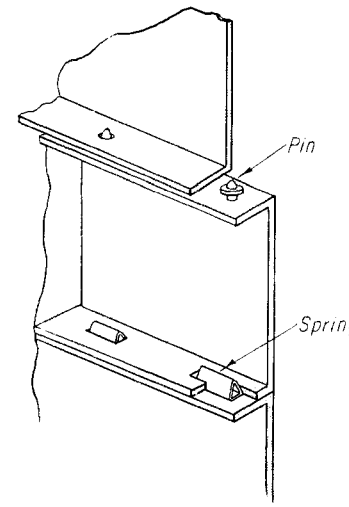

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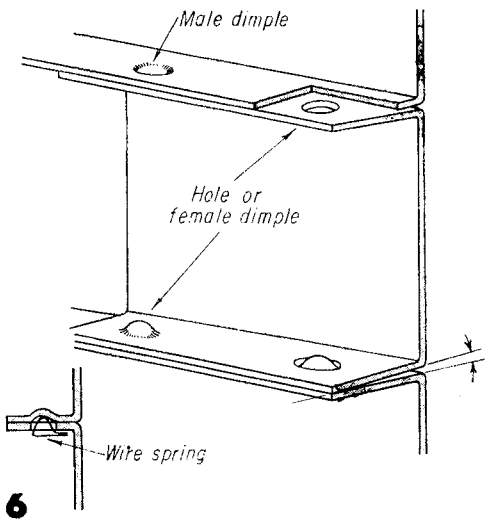
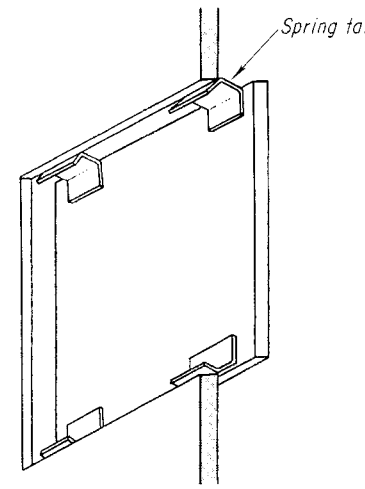
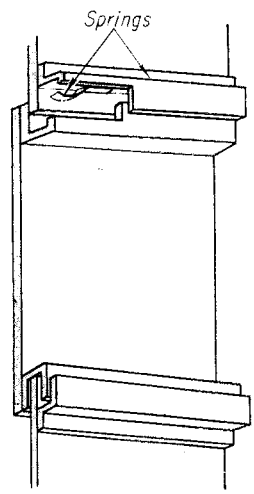


6



7



8

4..**LOUVER** fits into slot, which should be longer than the louver for easy alignment, but narrower—for a tight hold.

5..**TWO PINS** or more on top, with matching springs below, keep wide panels from rattling. One pin and a wide spring are enough for narrow panels.

6..**DIMPLES** in cabinet flange fit into corresponding dimples or holes in panel. Wire spring is alternate method. Sloping panel flanges give close fit with less exact dimensions.

7..**SPRING TABS** have slope on front to guide panel into place, and slope on back to hold it there.

8..**MATING CHANNELS** interlock for positive hold. To remove, lift panel against flat springs and swing bottom out and down.

20 Tamper-proof Fasteners

Ways to prevent or indicate unauthorized removal of fasteners in vending machines, instruments, radios, TV sets and other units. Included are positively retained fasteners to prevent loss where retrieval would be difficult.

Federico Strasser

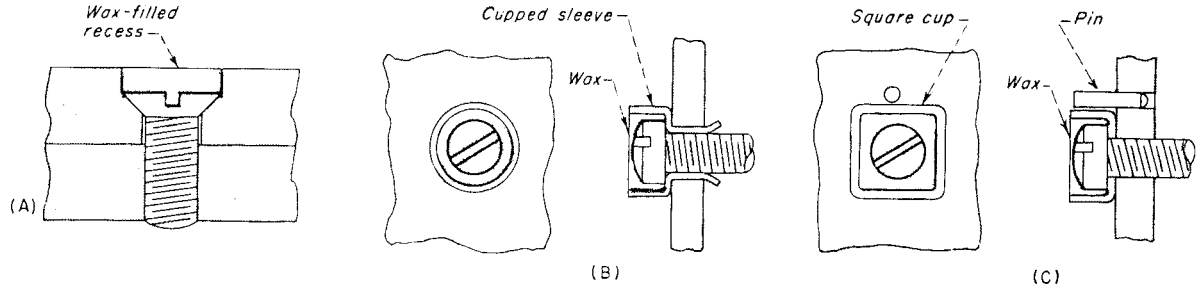


Fig. 1—(A) Wax or other suitable material fills recess above screw. Wax flush with plate hides screw position if surface is painted. (B) Cupped sleeve riveted in screw hole provides cavity for wax when plate is too thin for recessing. (C) Pin prevents rotation of square cup which would allow screw to be removed without disturbing wax.

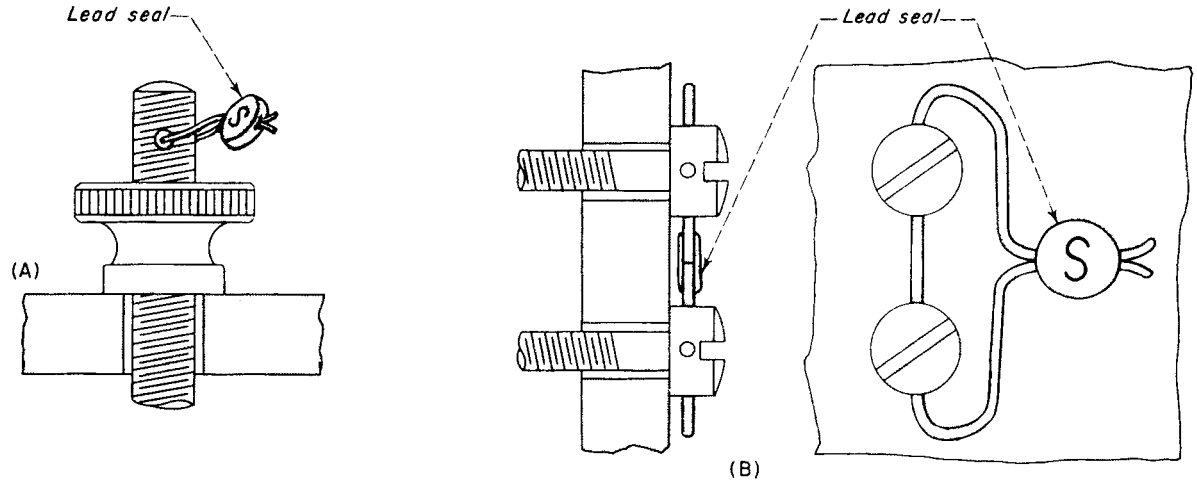


Fig. 2—(A) Lead seal crimped over twisted ends of wire passing through screw allows only limited slackening of nut. (B) Two or more screws strung through heads with wire are protected against unauthorized removal by only one seal. Code or other signet can be embossed on seals during crimping.

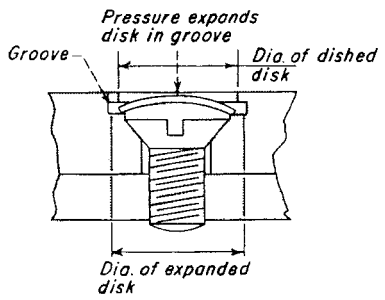


Fig. 3—Sheet-metal disk pressed into groove can only be removed with difficulty and discourages tampering.

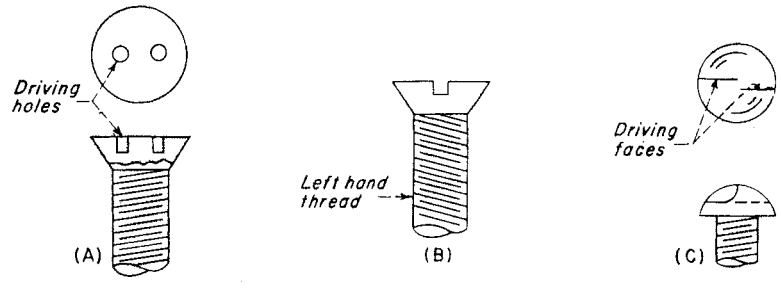
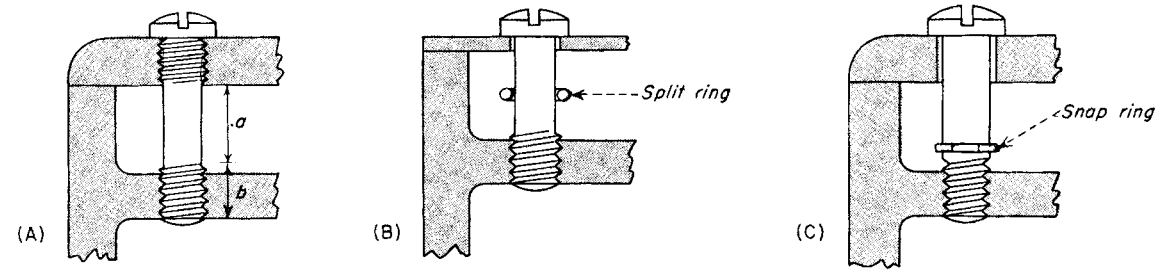


Fig. 4—(A) Spanner-head screws are available in all standard heads and sizes from U.S. manufacturers. Special driver is required for each screw size except ¼-in. dia and above. (B) Left-hand screw thread is sometimes sufficient to prevent unauthorized loosening, or (C) special head lets screw be driven but not unscrewed.

POSITIVELY RETAINED FASTENERS



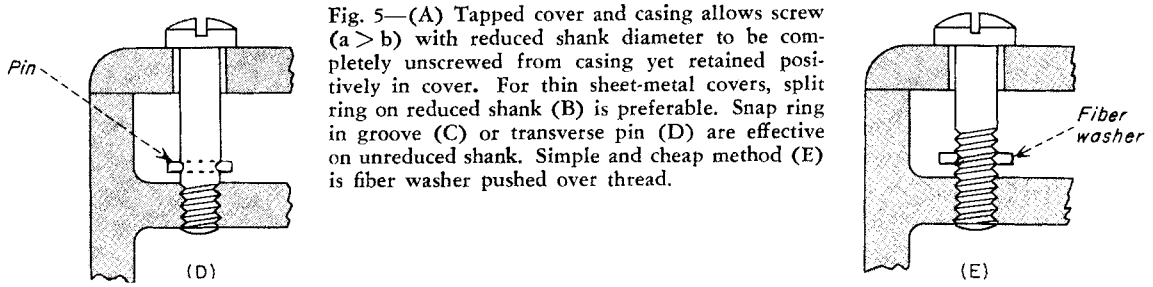


Fig. 5—(A) Tapped cover and casing allows screw (a > b) with reduced shank diameter to be completely unscrewed from casing yet retained positively in cover. For thin sheet-metal covers, split ring on reduced shank (B) is preferable. Snap ring in groove (C) or transverse pin (D) are effective on unreduced shank. Simple and cheap method (E) is fiber washer pushed over thread.

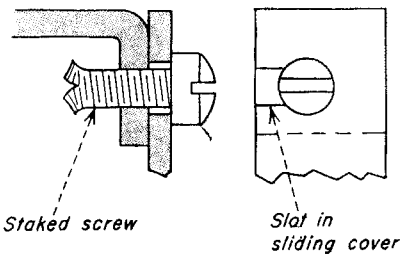
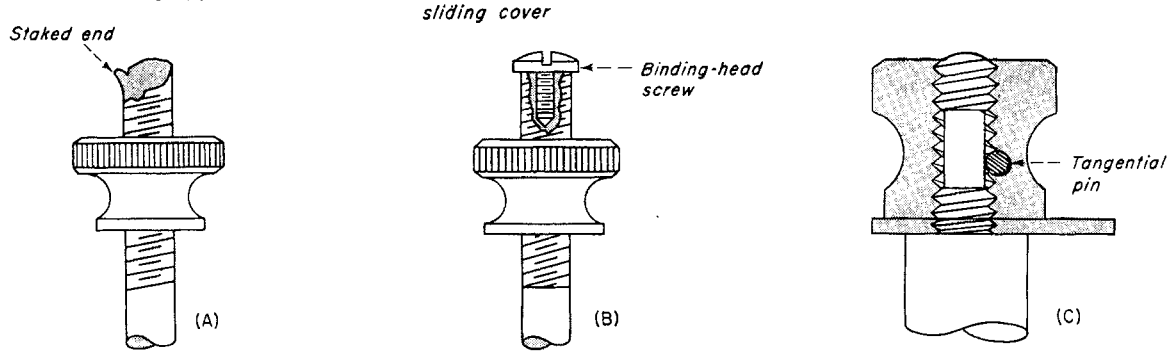


Fig. 6—Open-ended slot in sliding cover allows screw end to be staked or burred so screw cannot be removed, once assembled.



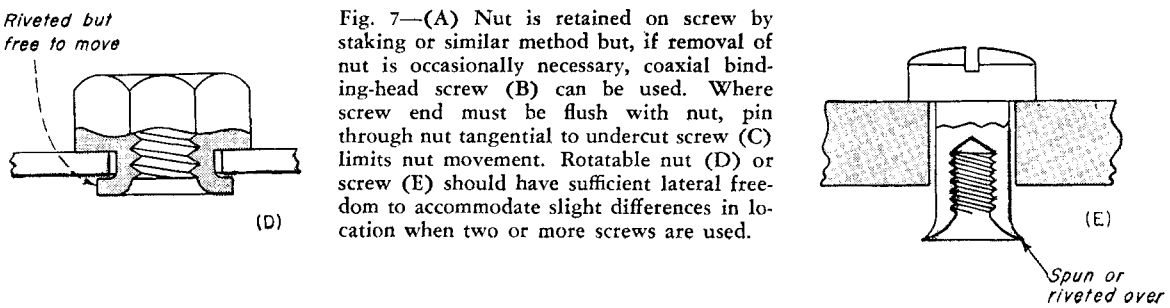
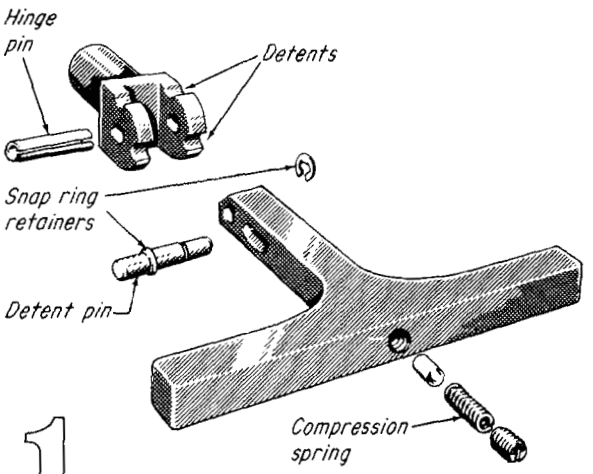


Fig. 7—(A) Nut is retained on screw by staking or similar method but, if removal of nut is occasionally necessary, coaxial binding-head screw (B) can be used. Where screw end must be flush with nut, pin through nut tangential to undercut screw (C) limits nut movement. Rotatable nut (D) or screw (E) should have sufficient lateral freedom to accommodate slight differences in location when two or more screws are used.

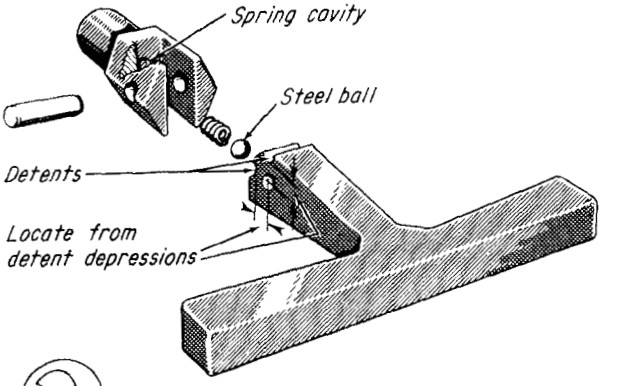
8 Detents for Clevis Mounting

When handles are mounted in clevises they often need to be held in one or more positions by detents. Here are ways to do this.

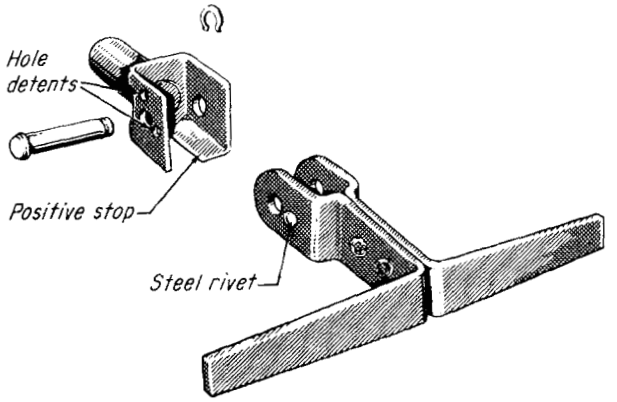
Irwin N. Schuster



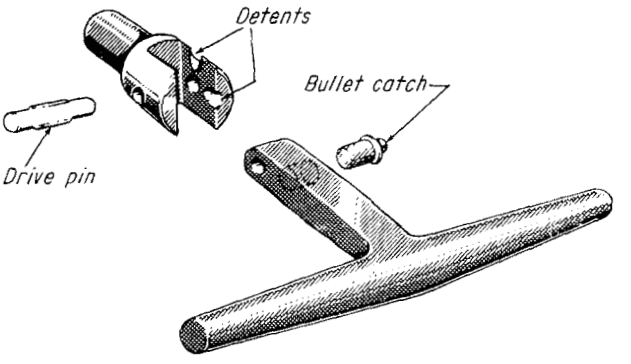
1 **CAST OR MILLED** clevis features an adjustable tensioning device, which varies the follower load. Handle can be extruded section.



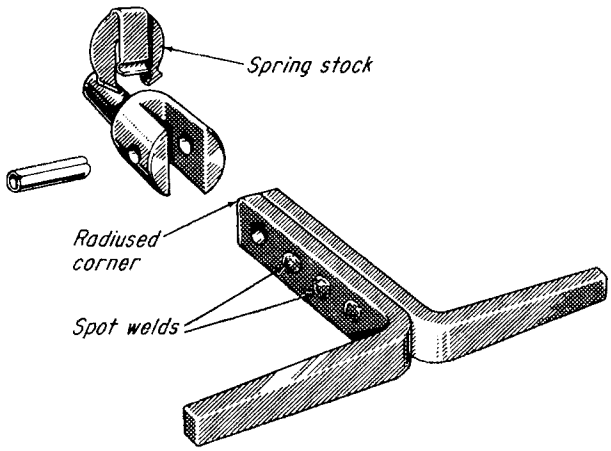
2 **CLEVIS MACHINED** from hexagonal stock can be drilled to receive a ball detent, which acts in cammed surfaces cast in handle.



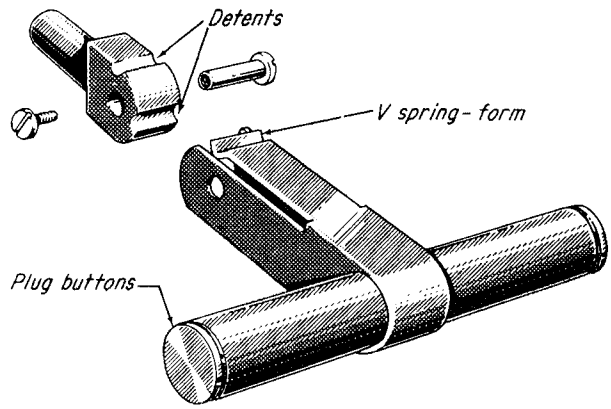
5 **WELDED CLEVIS** is relieved to improve spring characteristics. Punched holes receive steel rivet head which acts as the detent.



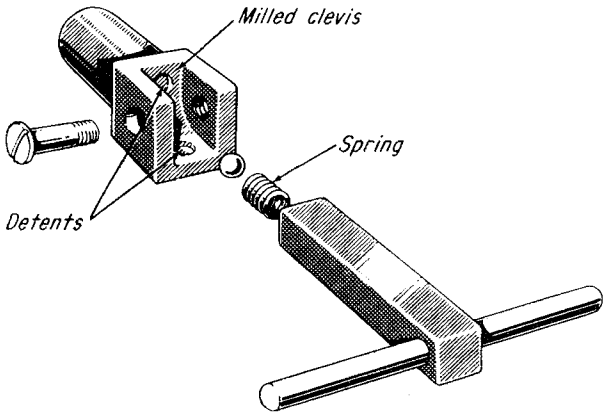
6 **CAST HANDLE** is drilled to accept a commercial "bullet" catch, which detents in the milled internal surface of the clevis flanges.



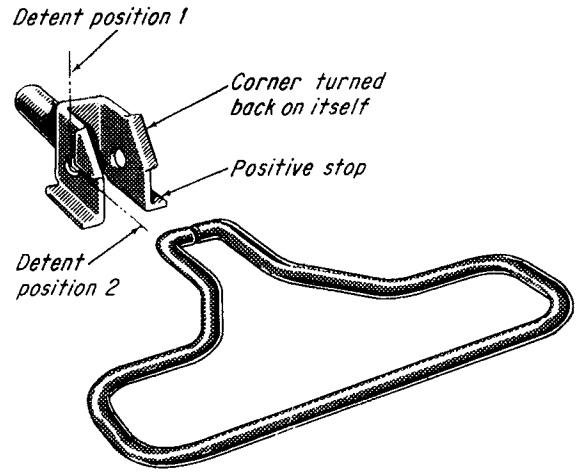
3 **STAMPED SPRING** snaps onto clevis before final assembly and acts as detent against the flat end and top surfaces of metal handle.



4 **TUBE AND SHEETMETAL** clevis handle has integral leaf spring which detents in cammed surface of machined shaft head.

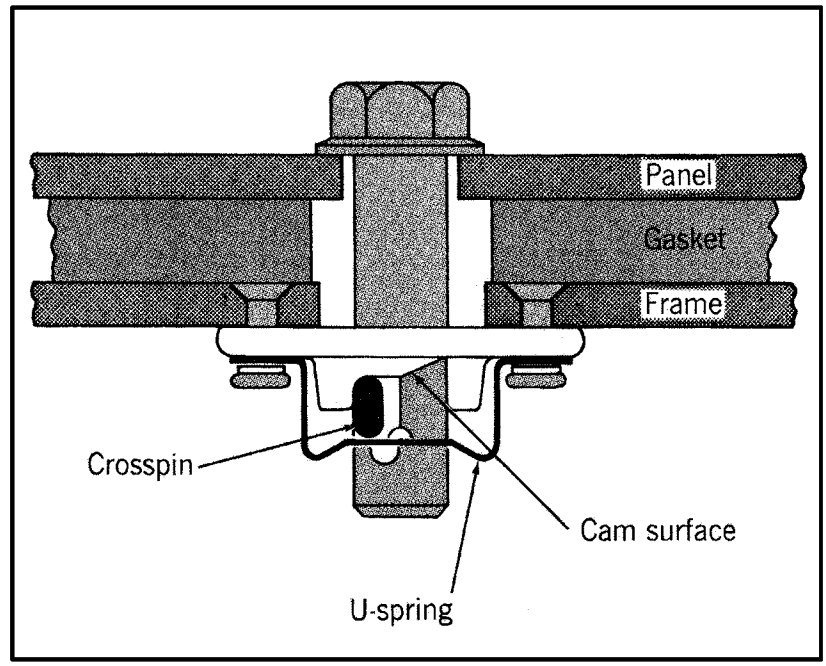


7 **MILLED CLEVIS** accepts ball-bearing follower, actuated by a spring, which seats against a pivot pin in the bar and rod handle.

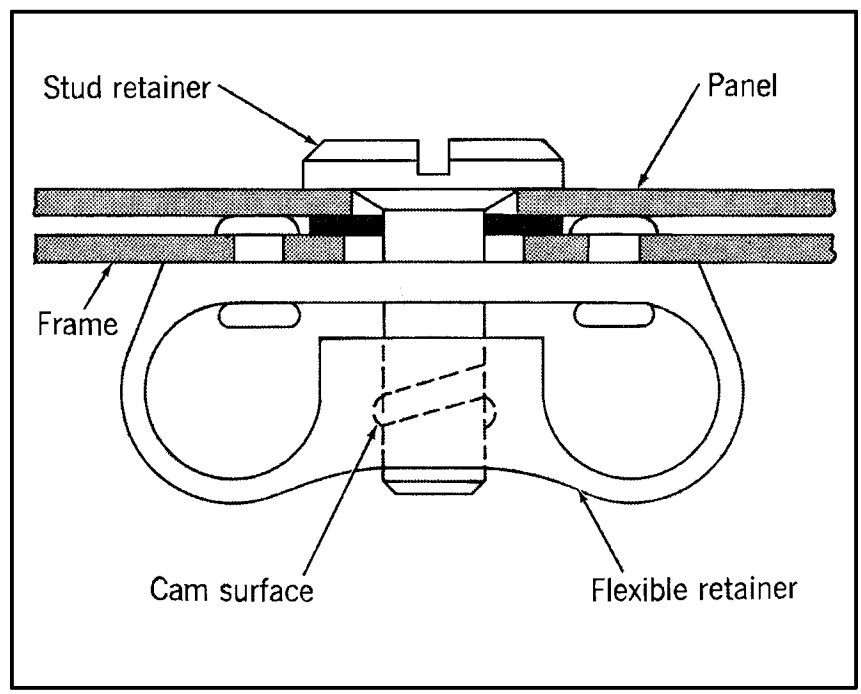


8 **WIRE HANDLE** acts as spring and follower in sheetmetal clevis, in which cammed surfaces and positive stops are made by bending.

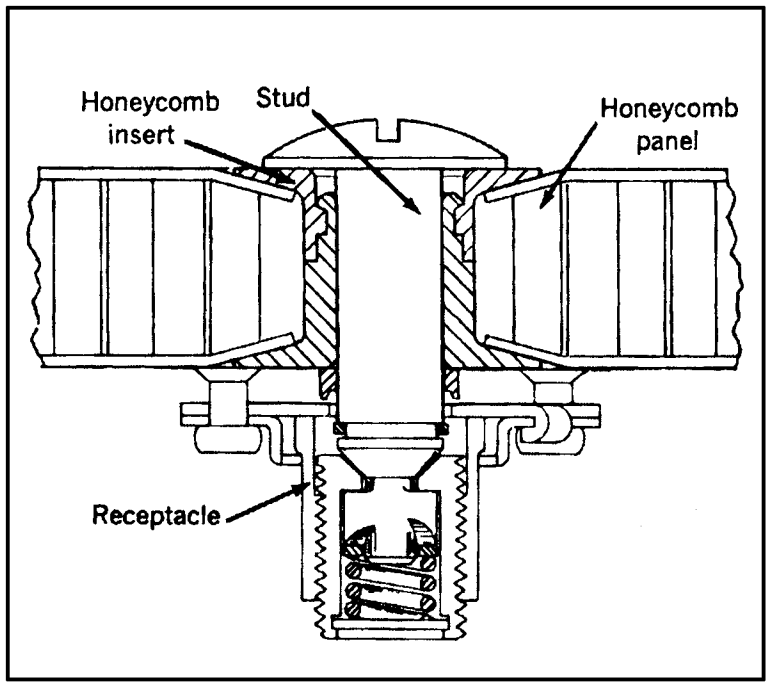
4 Locking Fastener Designs



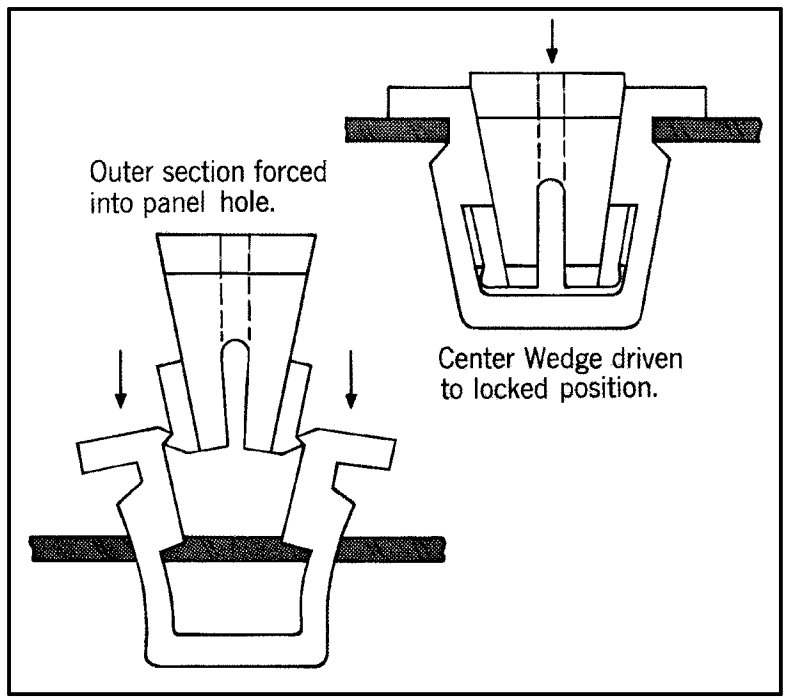
Quick-operating fastener has internal cam action to draw up or release a 300-lb. force with only a quarter-turn of wrench.



Springy all-plastic quarter-turn fastener with stylish head design can take sharp impact forces and resist corrosion.



Quarter-turn-fastener concept with through-core bolt makes it easy to attach honeycomb panel to a frame or structure.

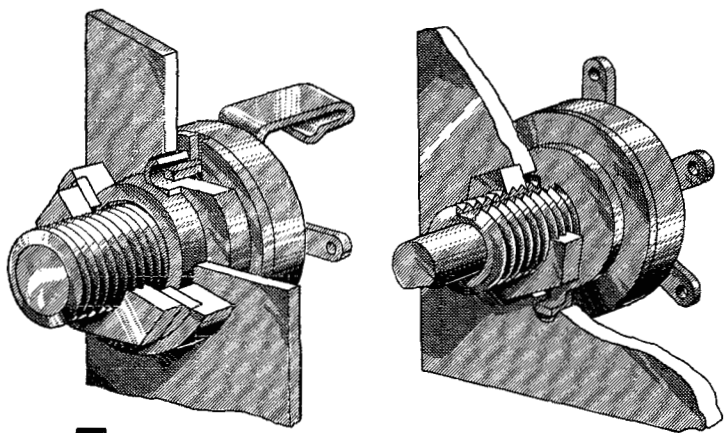


Knock-in fastener can be pushed easily into square-punched hole. Center is then knocked in to make receptacle for screw.

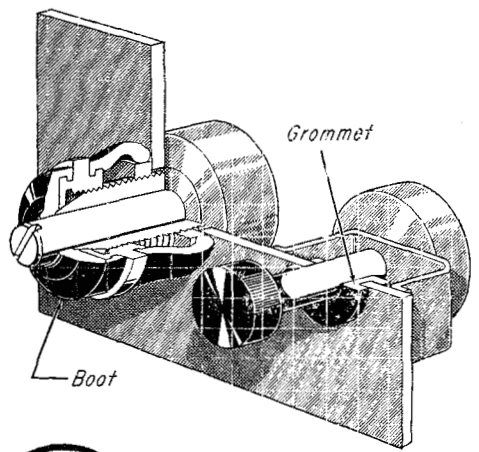
8 Control Mountings

When designing control panels follow this 8-point guide and check for...

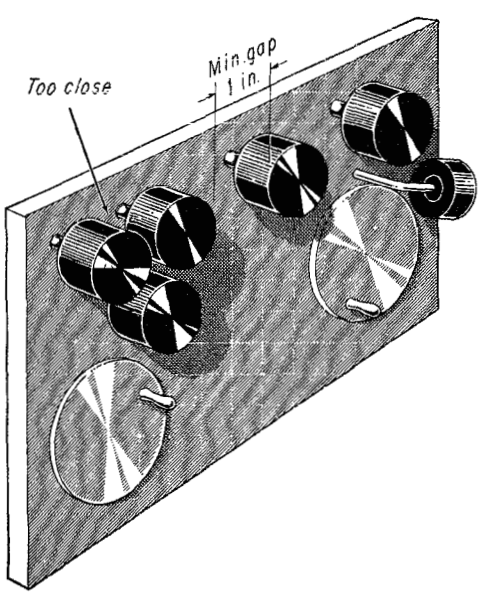
Frank William Wood JR



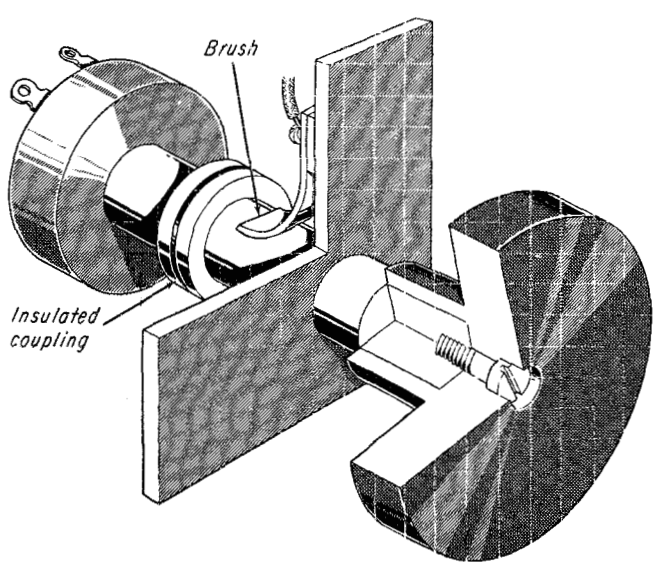
1 **...LOCKING.** Control will stay fixed in spite of vibration or attempts to force shaft too far. Washer at right has two tabs; one fits in the panel, the other in the control bushing. Left washer has a boss which fits into a cutout in the panel and around a pin projecting from the control body.



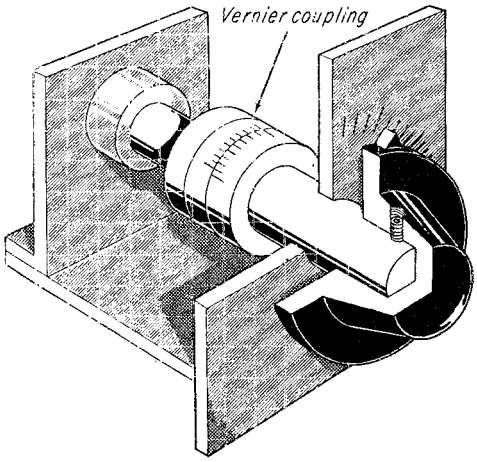
2 **...SEALING** against dust or water. Boot seals between shaft and bushing and between bushing and panel. With control behind panel rubber grommet seals only one place.

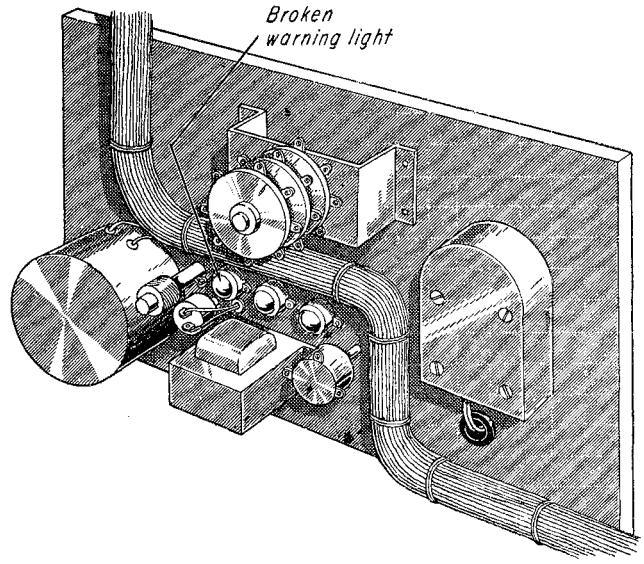


5 **...HAND-ROOM** at front of the panel. Space knobs at least one inch apart. Extending knob to save space puts it where the operator can bump into it and bend the shaft. Best rule is to keep shaft as short as possible.



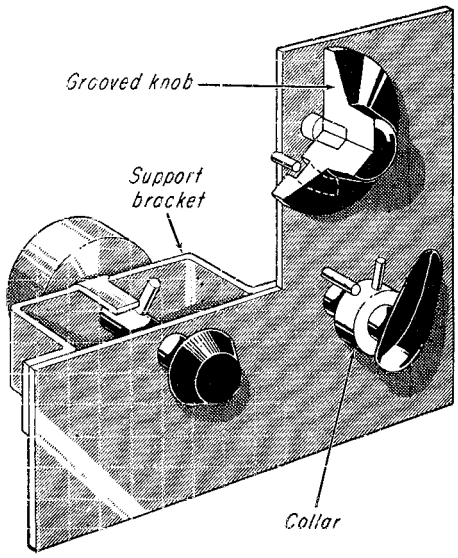
6 **...“HOT” CONTROL KNOBS.** One approach is to ground them by installing a brush against the shaft. Another solution is to isolate the control by an insulated coupling or a plastic knob having recessed holding screws.

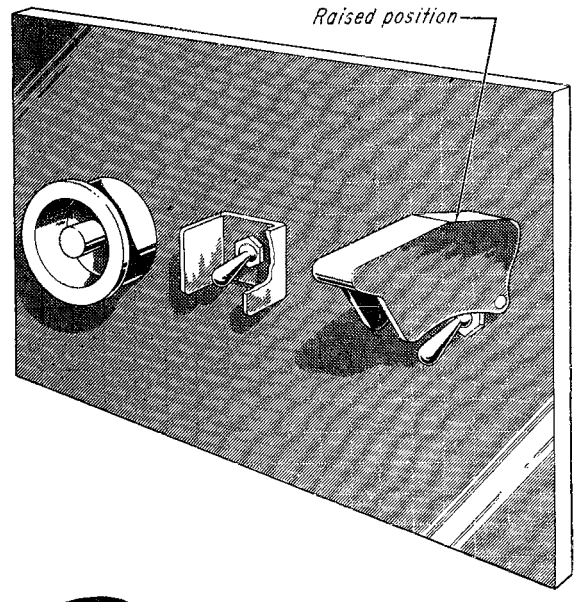




3 . . . **RESETTING** to match controls to panel markings. For crude adjustments a set-screw is enough. Where matching is critical a three-piece vernier coupling permits more accurate calibration.

4 . . . **ACCESSIBILITY** behind the panel. Easy access reduces down time and maintenance costs especially if one man can do most jobs alone. Here, technician can't replace a warning light without dismantling other parts.





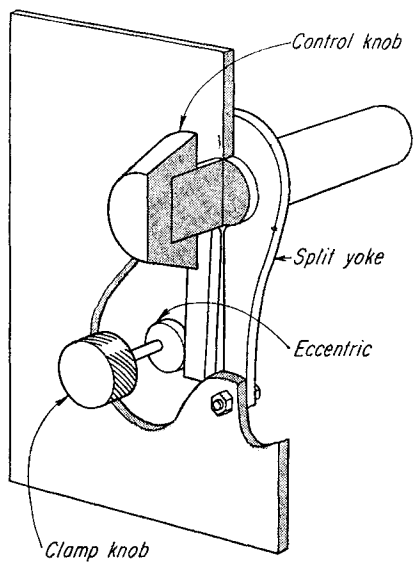
7 . . . **LIMIT STOPS** that are strong enough not to bend under heavy-handed use. Otherwise setting will change when stop moves. Collar and grooved knob permit adjustment; tab on bracket doesn't.

8 . . . **GUARDS** to prevent accidental actuation of switches. Bell-shape guard for push-buttons is just finger-size. U-shape guard separates closely spaced toggle switches, and a swinging guard holds down special ones.

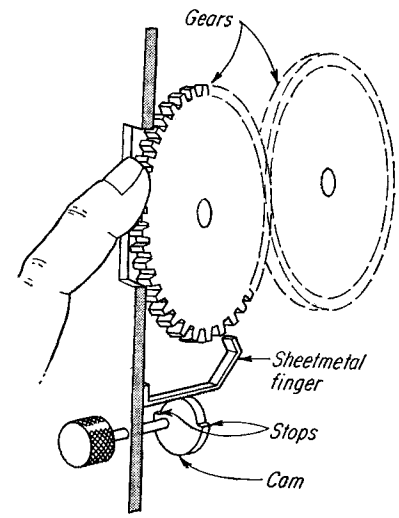
Control-Locks Thwart Vibration and Shock

Critical adjustments stay put—safe against accidental turning or deliberate fiddling with them.

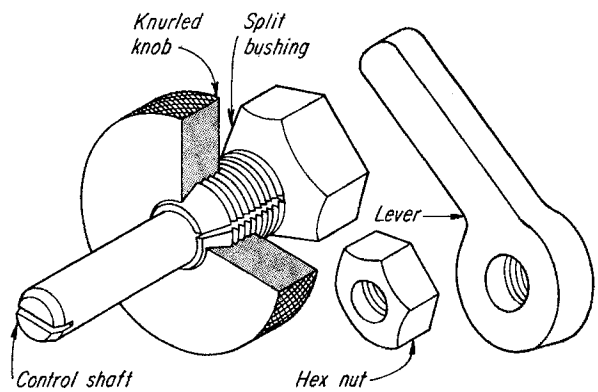
Frank William Wood JR



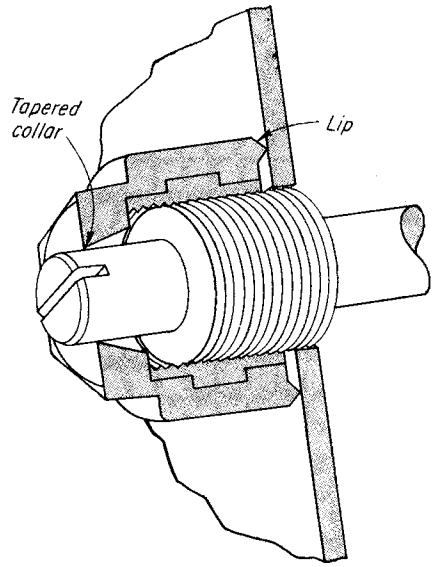
1..SPLIT YOKE clamps on shaft when eccentric squeezes ends of yoke together. Knurled knob is handy for constant use, and eliminates need for tool. Another advantage is high torque capacity. But this design needs considerable space on panel.



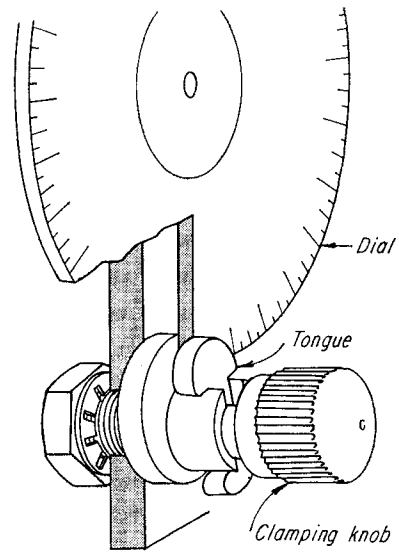
2..FINGER springs into place between gear teeth at turn of cam. Although gear lock is ideally suited for right-angle drives, size of teeth limits positioning accuracy.



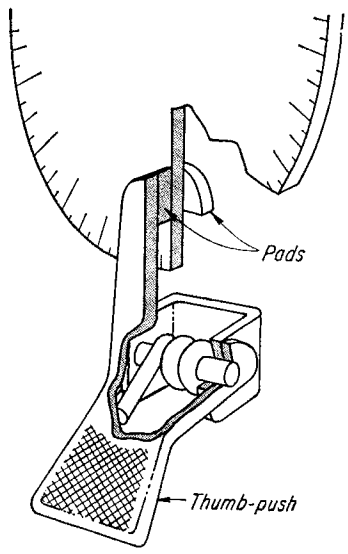
3..SPLIT BUSHING tightens on control shaft, because knurled knob has tapered thread. Bushing also mounts control to panel, so requires just one hole. Lever, like knob, does away with tools, but locks tighter and faster. For controls adjusted infrequently, hex nut turns a fault into an advantage. Although it takes a wrench to turn the nut, added difficulty guards against knob-twisters.



4..CONSTANT DRAG of tapered collar on shaft makes control stiff, so it doesn't need locking and unlocking. Compressed lip both seals out dust and keeps molded locking nut from rotating.



5..TONGUE slides in groove, clamps down on edge of dial. If clamp is not tight, it can scratch the face.

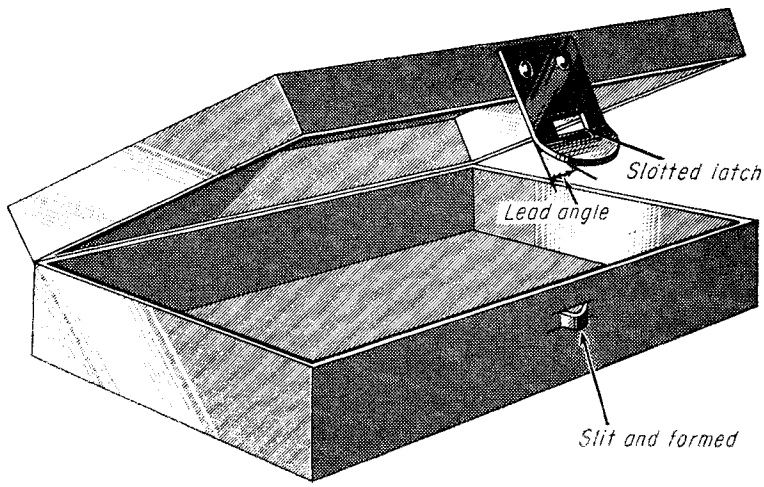


6..SPOT-BRAKE clamp is self-locking, which means it takes two hands to make an adjustment, one to hold the clamp open and one to turn the dial.

Low-Cost Latches

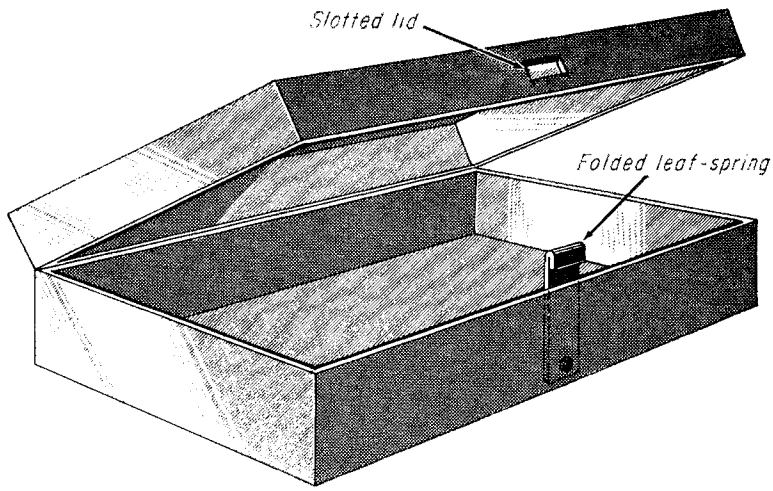
These latches cut costs where appearance is a secondary consideration.

L. Kasper



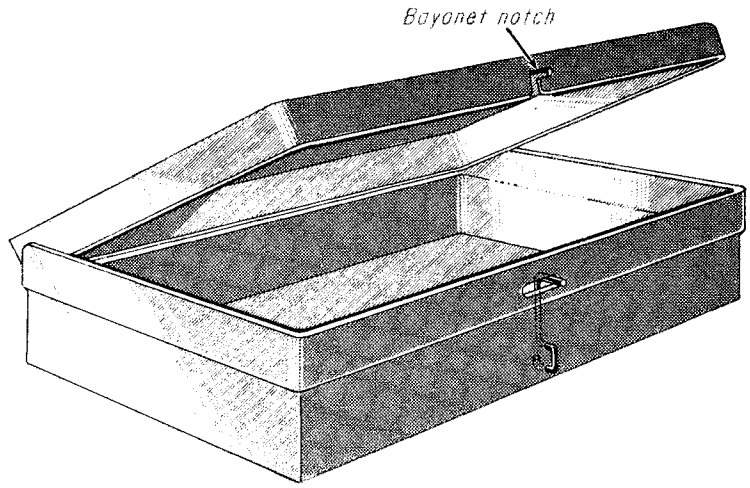
1

SLIT AND FORMED box side depends upon spring action of box metal and latch plate for engagement in latch-plate hole. A box that is too stiff will require a relatively flexible latch plate for ease of operation.



2

FOLDED LEAF-SPRING end is another positive, spring-action latch. Here, however, the leaf spring itself provides spring action – box can be as heavy as desired without interfering with opening or closing. Careful alignment of spring and notch is necessary.

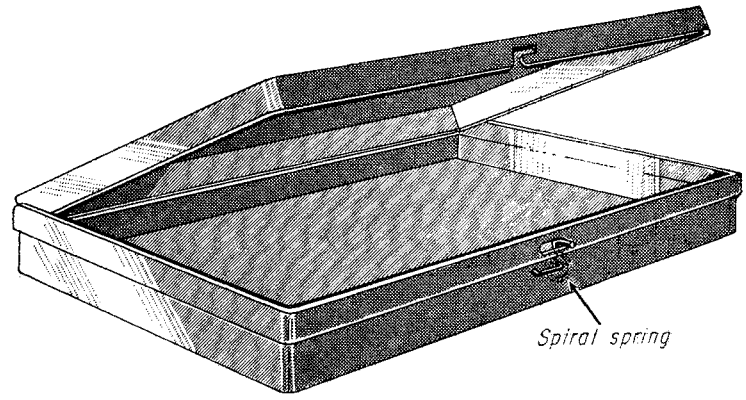


3

BAYONET ACTION of formed-wire spring in lid is again automatic upon closing. Spring must be manipulated for opening unless a lead is deliberately designed into the lid notch so that opening force can overcome holding-force.

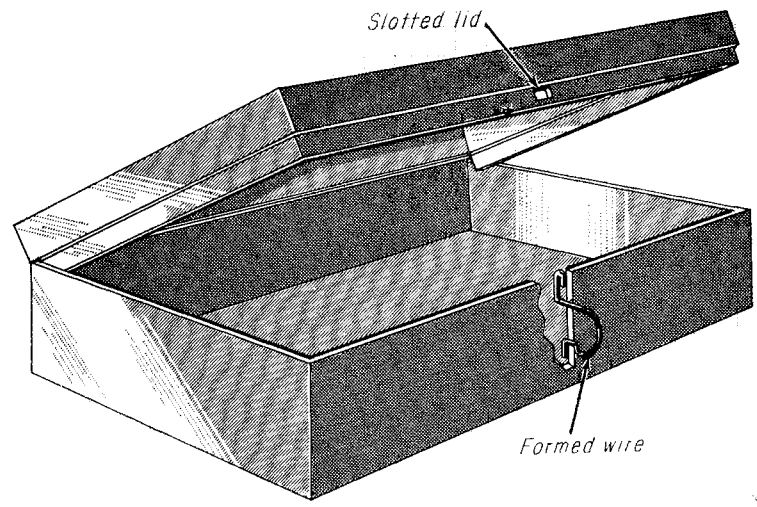
4

SPIRAL SPRING holds the lid in a manner similar to the previous latch arrangement. Spring action comes from tension windup rather than cantilever and so design is suitable for boxes where a long latch spring is not possible.



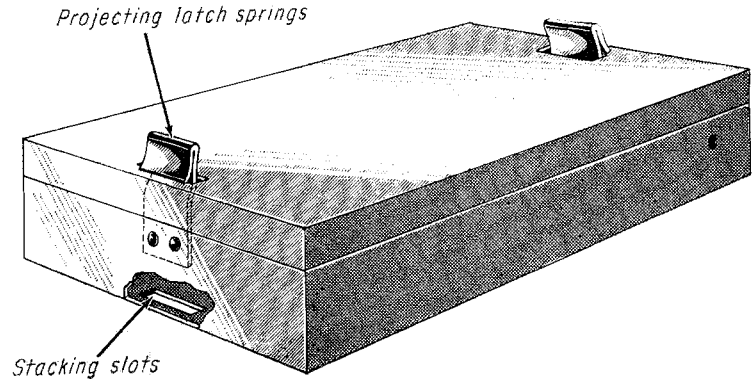
5

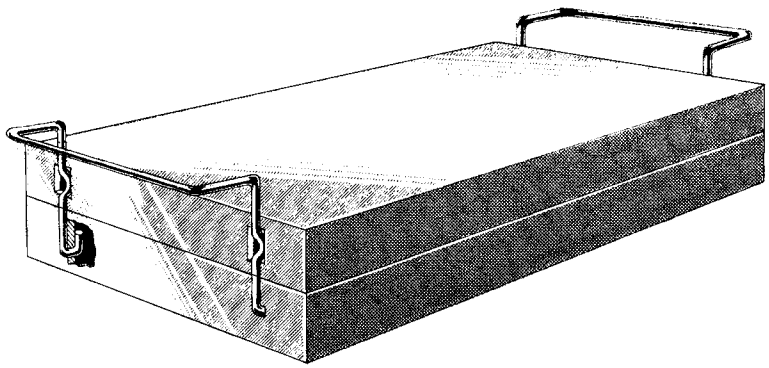
FINGER RING is here provided by forming the spring to do double duty – it not only performs as the latch spring but provides finger hold for withdrawing the box from a narrow shelf or desk drawer. Disadvantage is that protruding spring takes extra space.



6

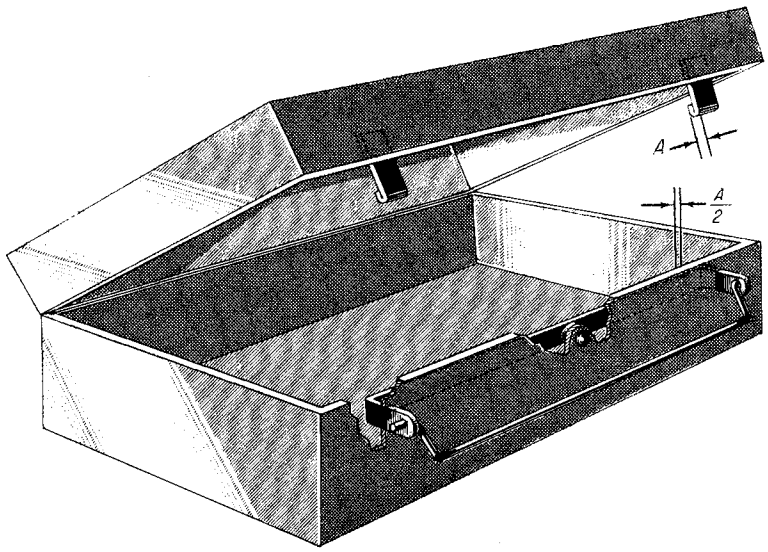
LATCH SPRINGS projecting through the box top provide for stacking by engaging a slot in the bottom of the box above. Several boxes can thus be carried without risk of sliding. The lid can be hinged or completely removable.





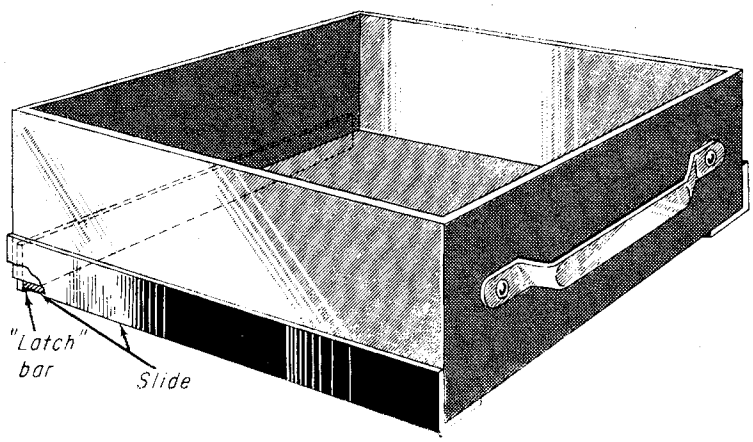
7

LATCH SPRING formed into shape of a handle is suitable for long, narrow boxes. The shape of the handle section permits several boxes to be stacked and carried safely.



8

CARRYING-HANDLE is attached to the latch spring, which is attached to its center with a spacer between. Press the handle to release the catch.

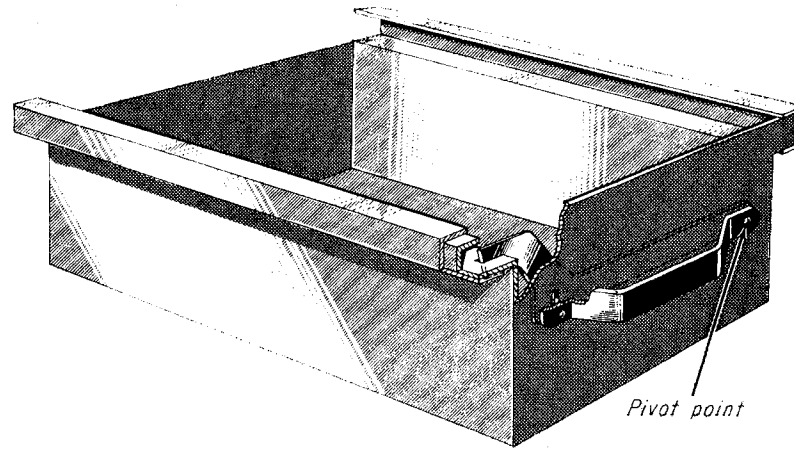


9

LATCH BAR at rear falls into slot when drawer is slid fully in. To withdraw, the box must be raised at the rear by tilting on the front edge. Effect is a self-locking, secret-opening drawer.

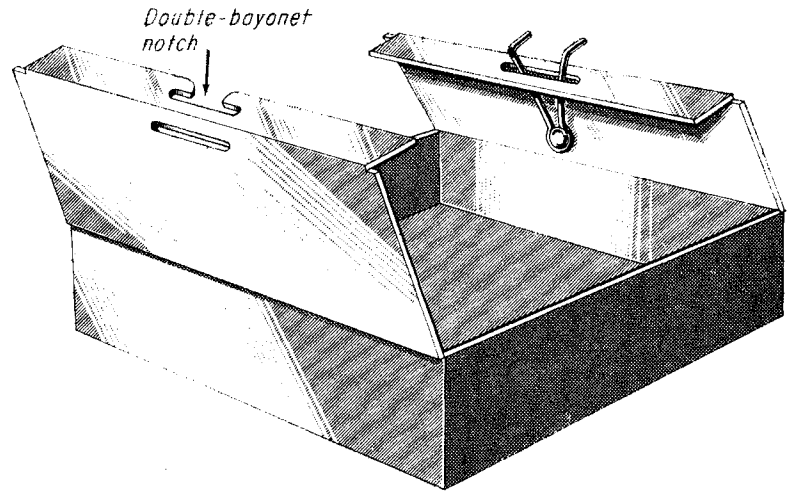
10

SWIVEL HANDLE is attached by shoulder screw at pivot point. To withdraw the drawer, tilt the handle about the pivot point until the latch is disengaged from slot in runner.



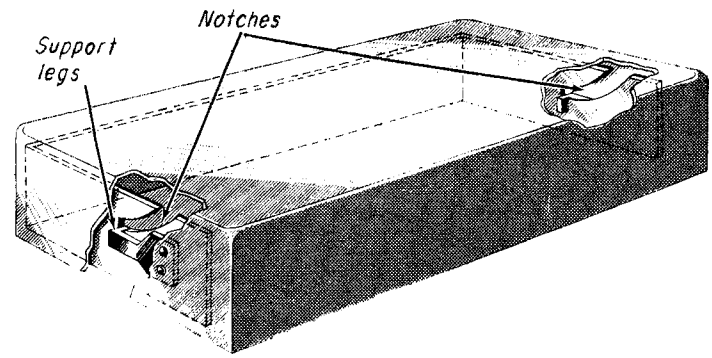
11

DOUBLE-BAYONET notch in one lid snaps over V-spring in other lid to hold box closed. Press spring to open. This type of latch is very suitable for long, narrow boxes.



12

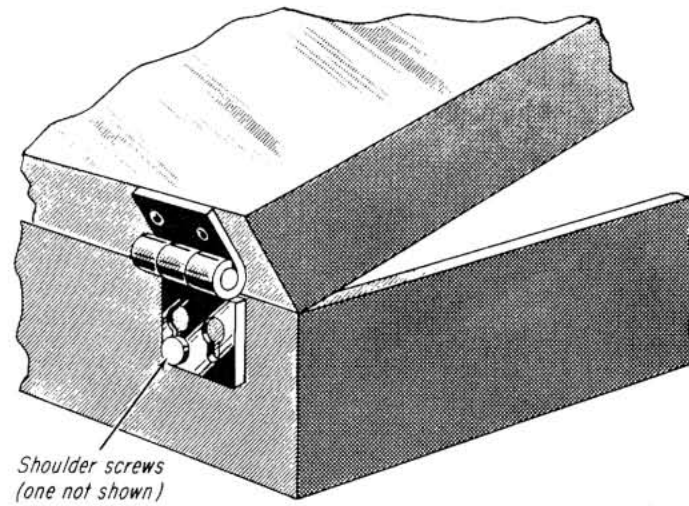
NOTCHES are specially shaped to hold cover over instrument housing. Simply lift cover and slide out support legs to remove cover. If fit of legs and slides is made fairly tight, accidental removal or tampering is improbable.



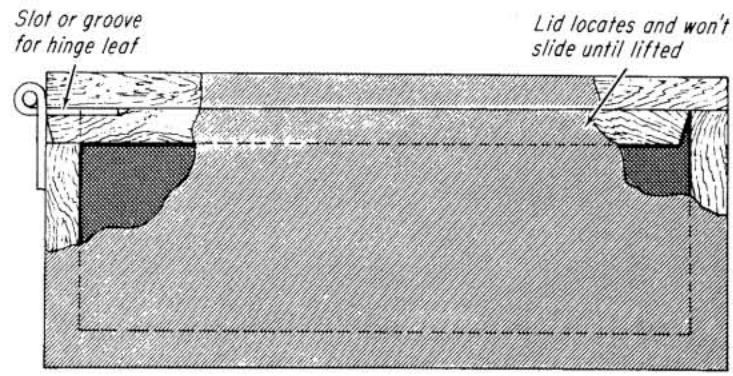
Hinged Lids That Separate

Keyslots, lid grooves, open hooks, sliding pins, and other features let hinged lids be completely removed.

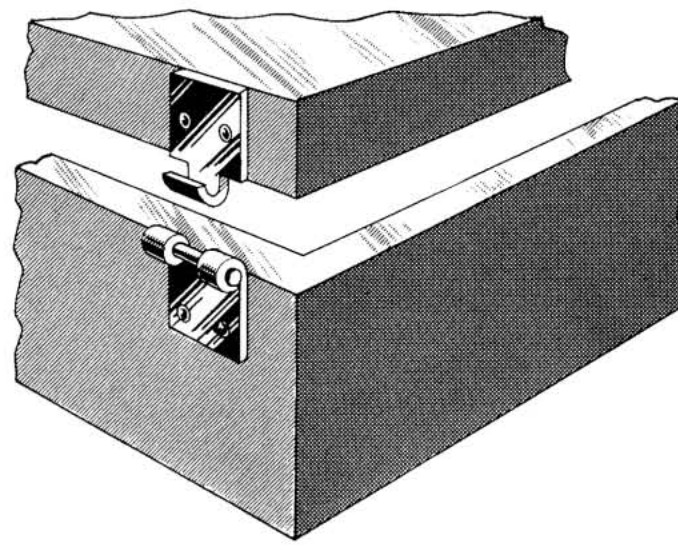
L. Kasper



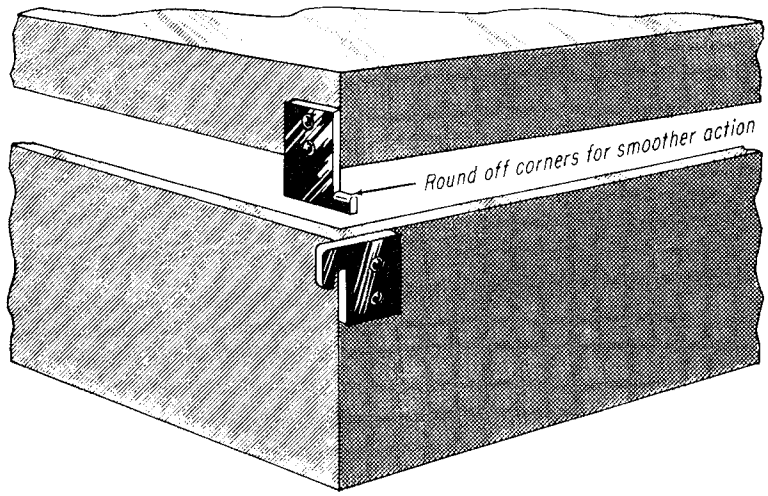
1 **KEYSLOTTING** one leaf of the hinge is a simple way to provide for separation of the lid from the box.



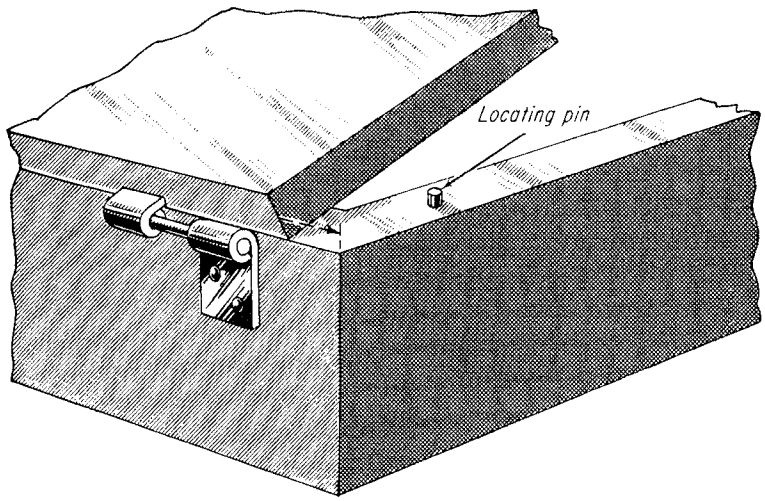
2 **LEAF CAVITY** in lid can be a simple groove. When lid locates against box sides, leaf cannot slip out.



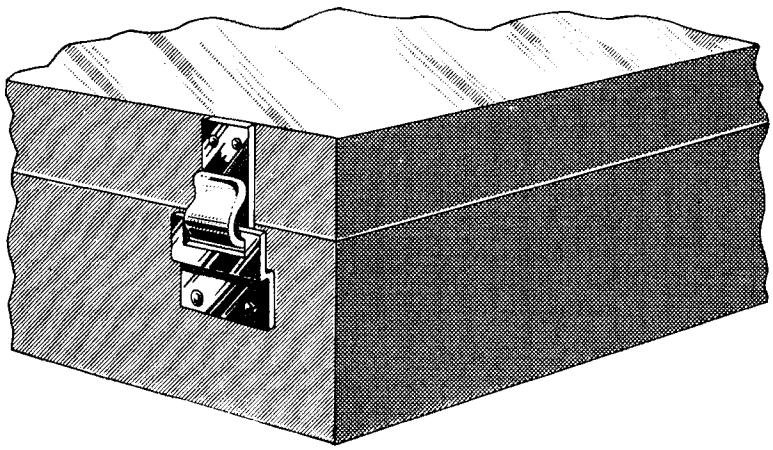
3 **OPEN HOOK** is formed by partly uncurling one leaf. To disassemble the lid it must be opened through 180 deg.



4 **FLAT PLATES** are hook and pin that act as efficient but low-cost hinge for rigid lids. Round off pin corners.



5 **SLIDING PIN** is popular way of making lids separable. Locating pins must be provided if lid does not fit in box.

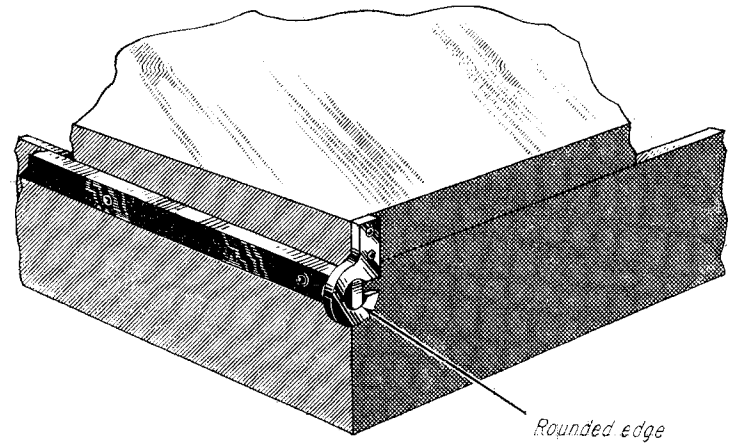


6 **SPRING-TYPE LEAF** must have enough clearance to accept retaining plate thickness unless spring is very light.

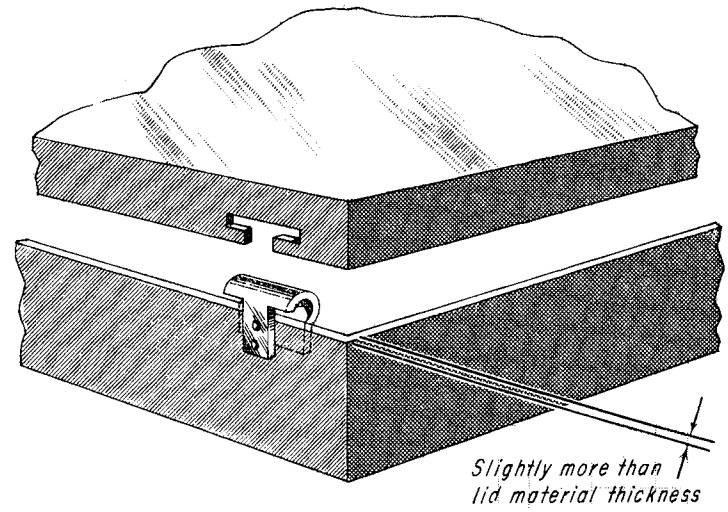
Hinge bars, notched lids, spring hing pins and other ways of providing for detachable lids.

L. Kasper

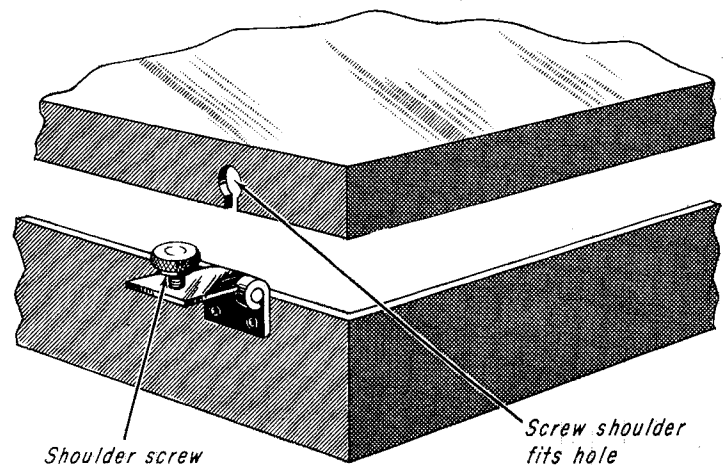
7 **HINGE-BAR AND HOOK** make strong and low-cost hinge, separable when lid is opened through 90 deg.



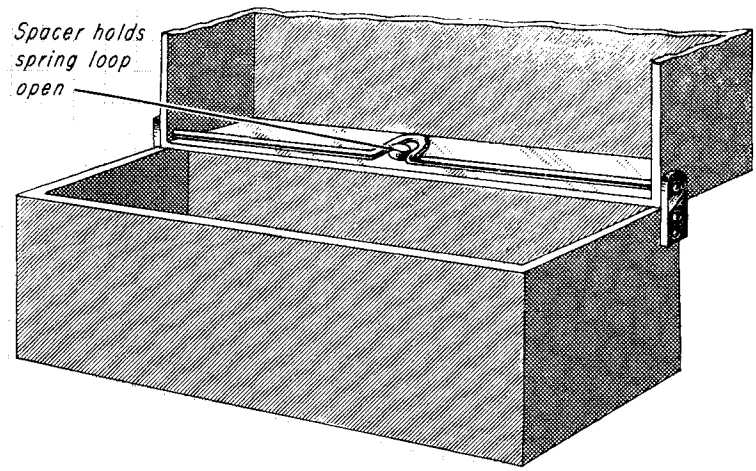
8 **NOTCHED LID** accepts hooked part of hinge plate when lid is opened beyond 90 deg. Only one plate is needed.



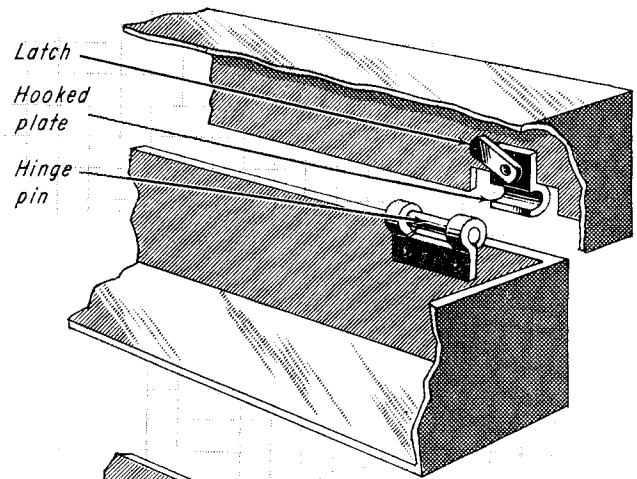
9 **SHOULDER SCREW** in hinge plate needs to be loosened to only slightly more than the thickness of lid to detach it.



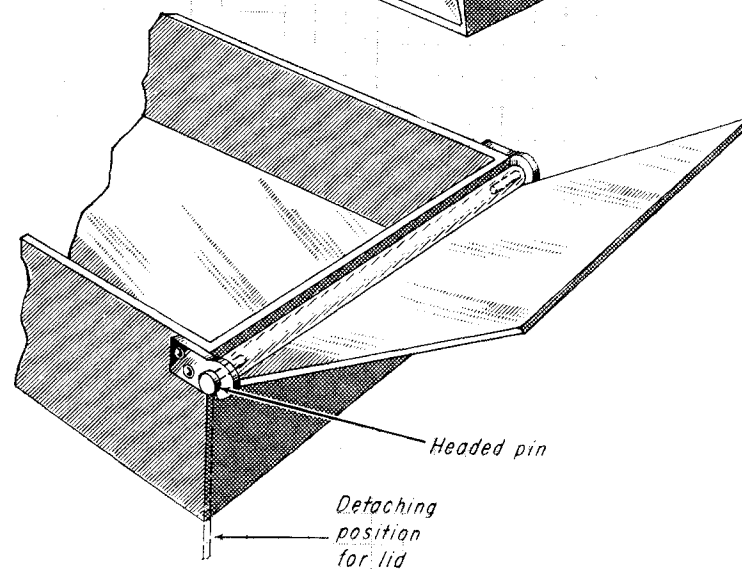
10 **LOOPED HINGE PIN** is sprung over spacer. When the loop is pulled off the spacer the pin ends retract.



11 **HOOKED MEMBER** is slipped under pin in position shown. When lid is opened latch can be turned to lock pin.



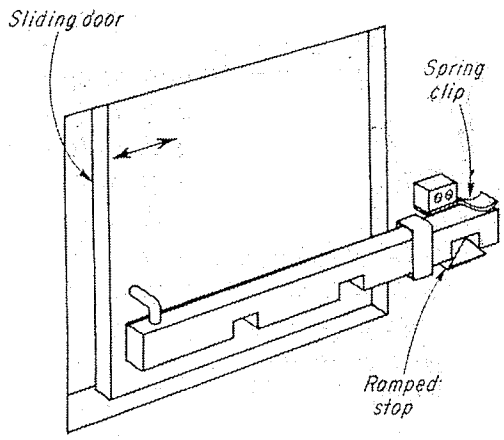
12 **HEADED PINS** are driven into curled lid edge. Heads are same diameter as the curl. Lid slides when opened 270 deg.



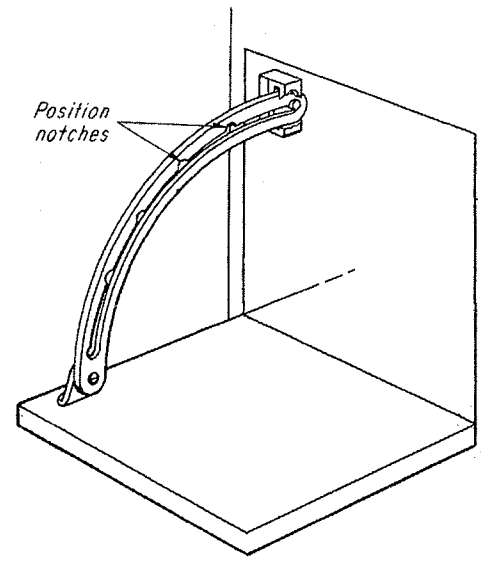
8 Stops for Panel Doors

They protect hings from overtravel and hold doors in working positions.

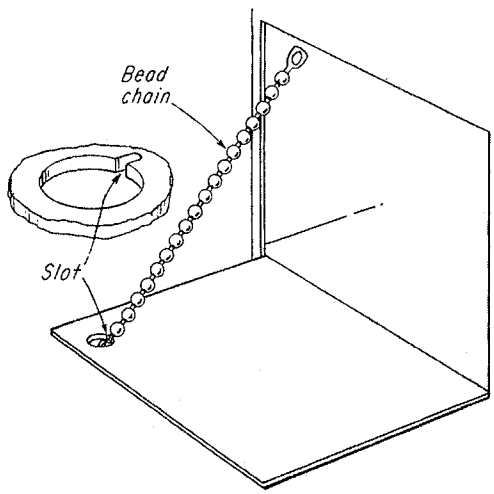
Frank William Wood JR



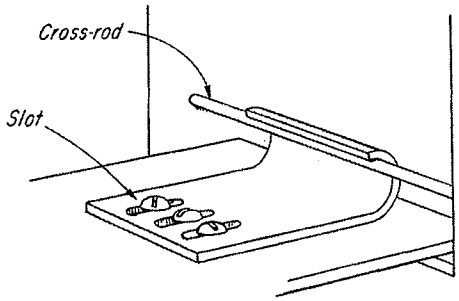
1.
SPRING CLIP presses notched bar down on stop for sliding door.



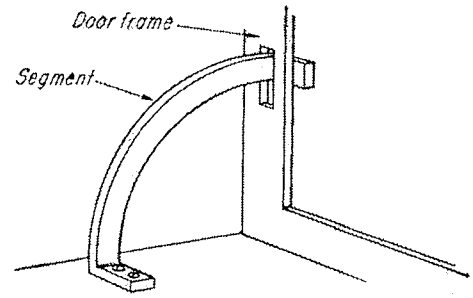
2.
SLOTTED BAR stops when pin jams against end; notches hold drop panel in intermediate positions.



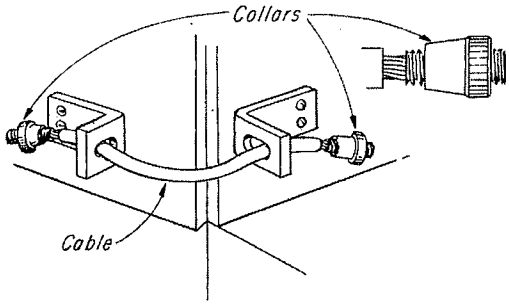
3.
BEADED CHAIN provides as many positions as there are beads. Keyhole slot allows repositioning.



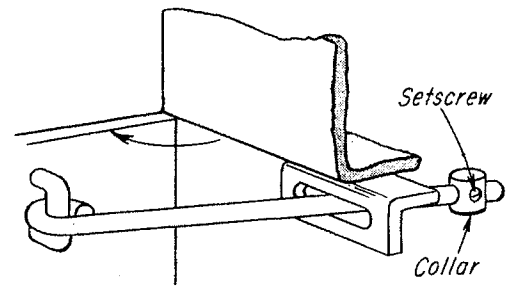
4.
WRAPAROUND back of bar comes to a stop against the cross-rod. Slots permit adjusting bar for different door opening.



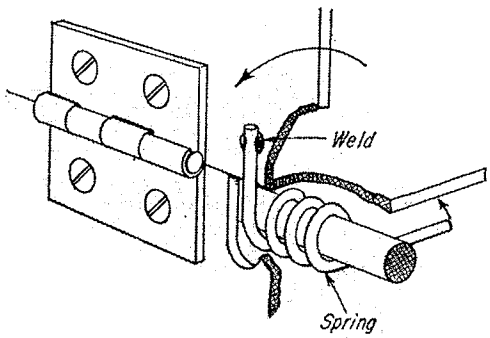
5.
DOG-LEG on end of segment butts against door frame.



6.
CABLE pulls taut on end collars, which screw back and forth for slight adjustment.



7.
COLLAR slides along rod to adjust stopping point.

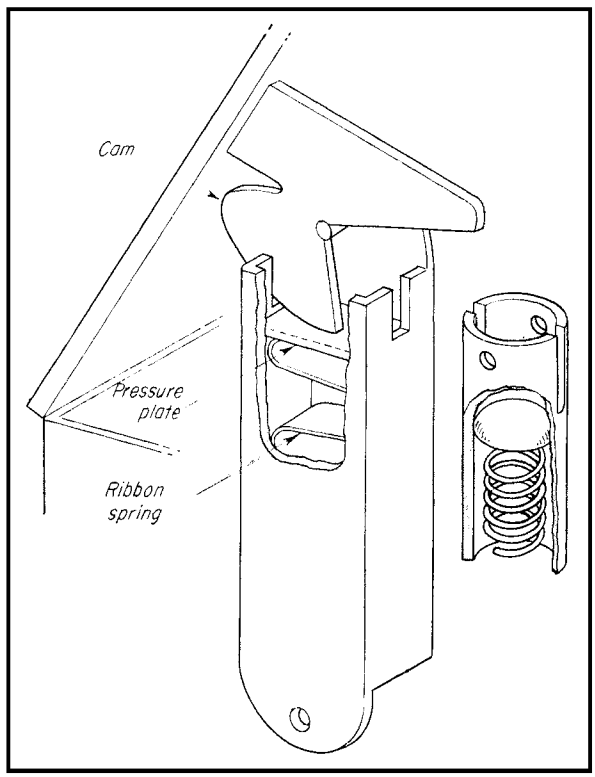


8.
COIL SPRING swings into underside of shelf and cushions door to a soft stop.

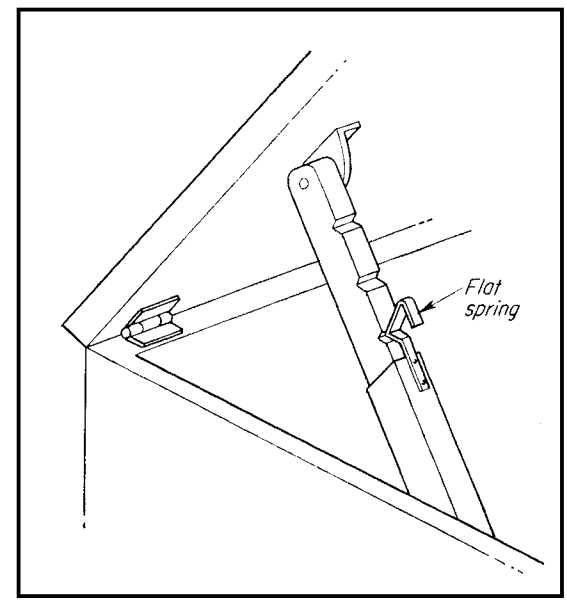
Panel-Stops Leave Hands Free

They hold open panel doors while repairs or adjustments are made.

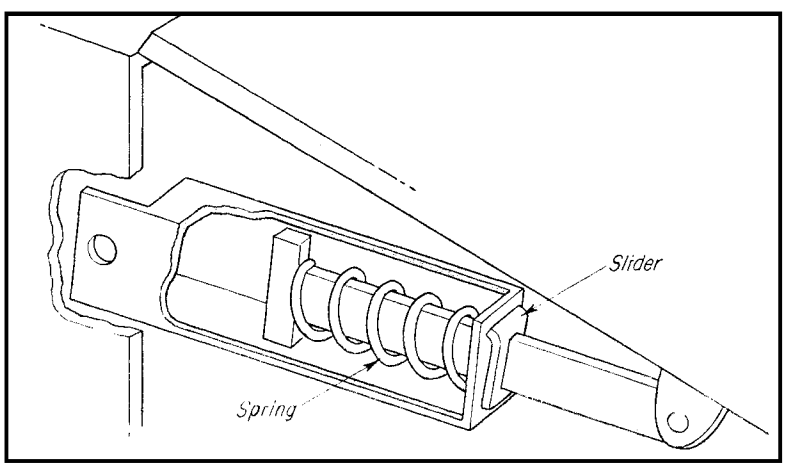
Frank William Wood JR



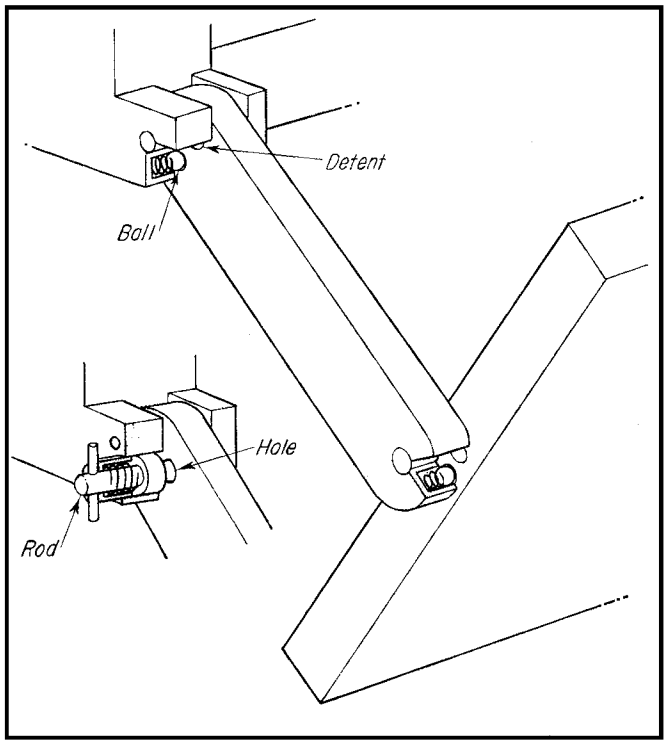
1
CAM rubs on spring-loaded pressure plate. Resulting friction holds panel open at any position. Tubular spring-holder has helical instead of ribbon spring.



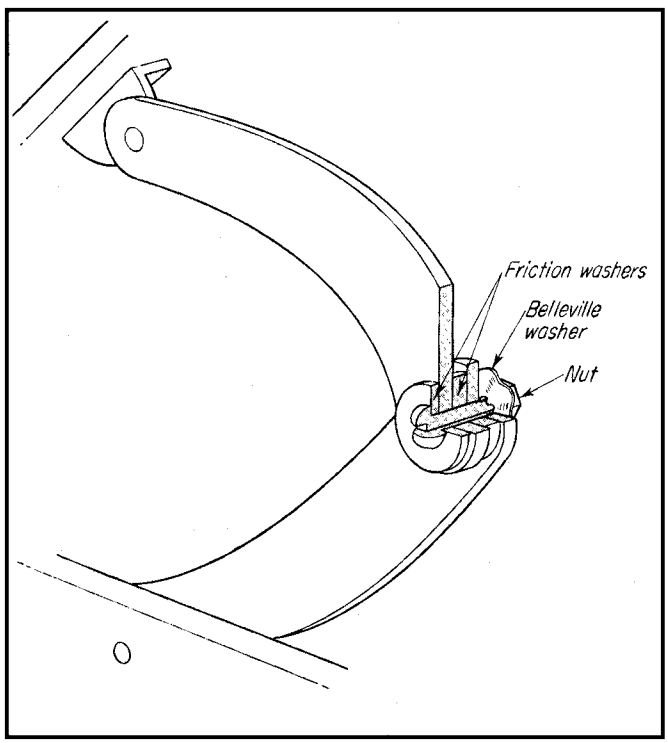
2
NOTCHED BAR catches on flat spring at only a few positions. Serrations increase number of positions. Heavier flat spring holds by friction at any position.



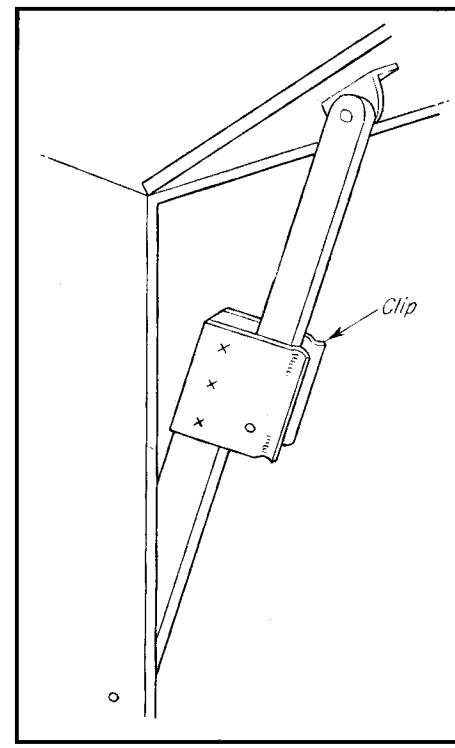
3
SLIDER jams when pulled against spring case, but slides freely after raising the panel slightly releases pressure. Spring holds panel shut.



4
DETENTS at both ends of swinging bar cup spring-loaded balls. Rod snaps into holes for more positive hold, but must be pulled out to release. Both methods will hold panel shut.



5
FRICTION WASHERS hold panel in any position, but are susceptible to vibration. Tightening down on spring washer adjusts drag for weight of panel. Knurled knob in place of nut allows tightening at desired position.

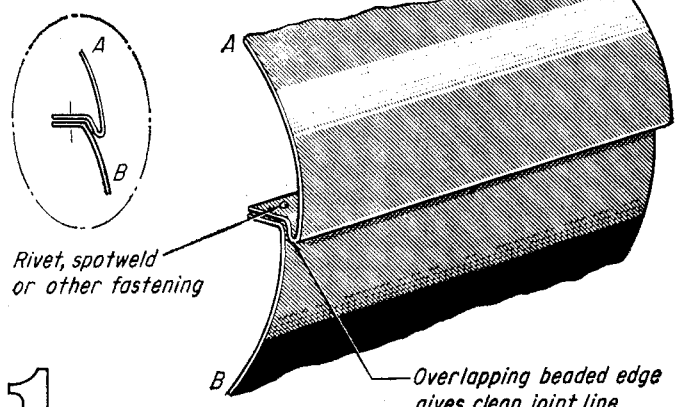


6
CLIP can hold panel door in only one position—open. Push on clip to release.

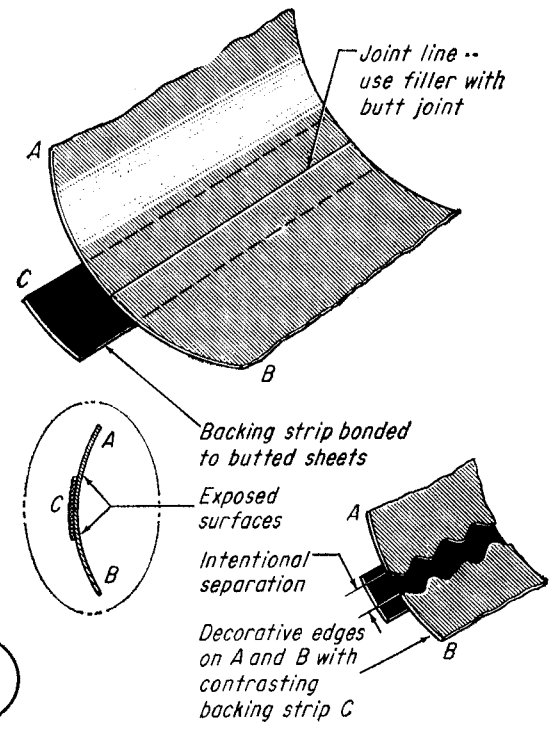
Better Looking Sheetmetal Joints

Improve their appearance with overlapping beads, backing strip, push-in trim strip, stick-on decals, recessed joints, inverted channels, and painted band.

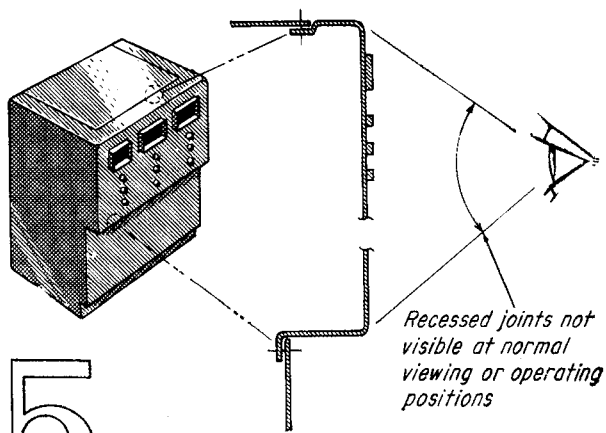
Frank William Wood JR



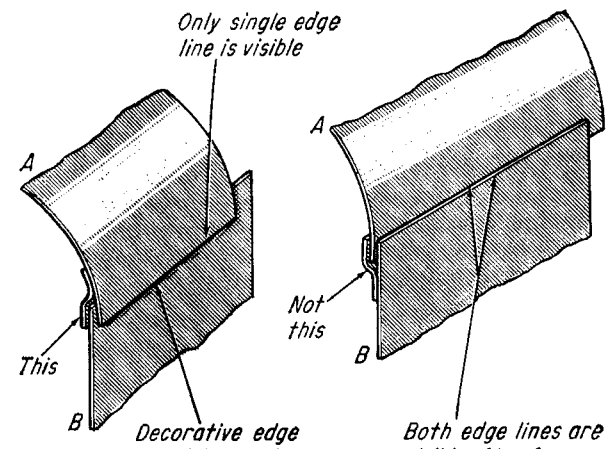
1 OVERLAPPING BEAD



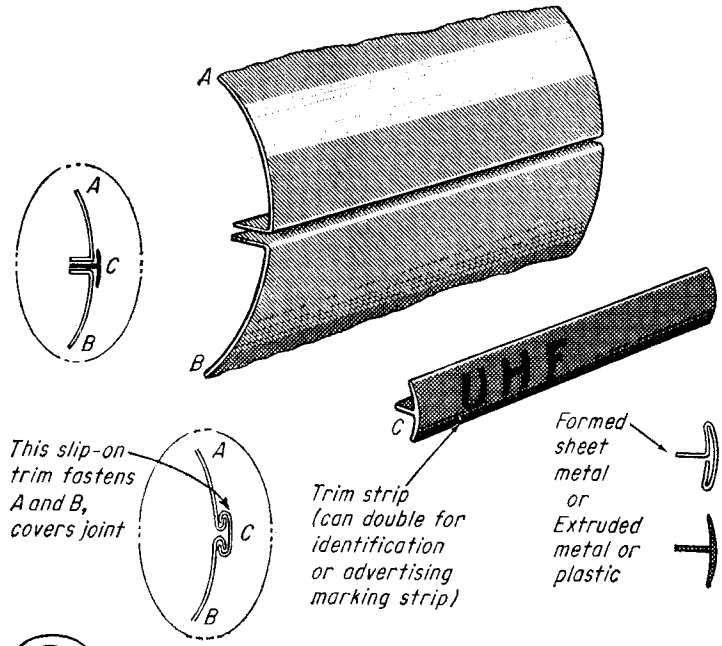
2 BACKING STRIP



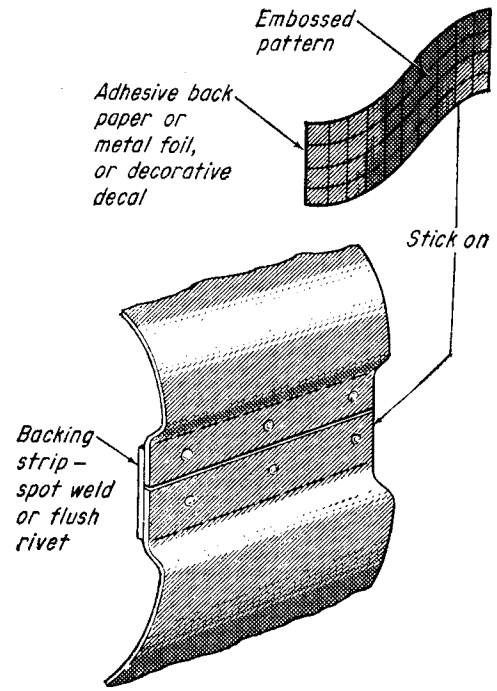
5 RECESSED JOINT



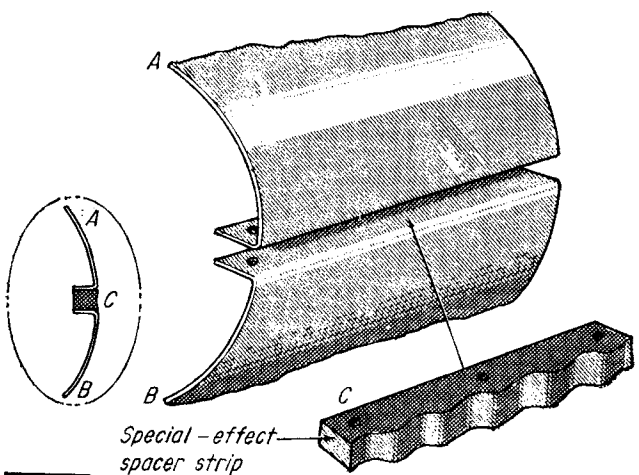
6 INVERTED-CHANNEL JOINT


A
B
C
This slip-on trim fastens A and B, covers joint
Trim strip (can double for identification or advertising marking strip)
Formed sheet metal or Extruded metal or plastic

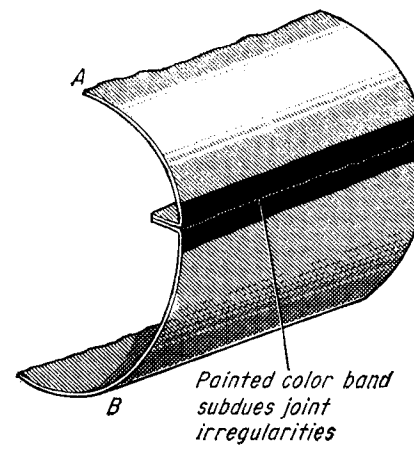
3 TRIM STRIP



4 DECALCOMANIA STRIPS



7 SPACER STRIP

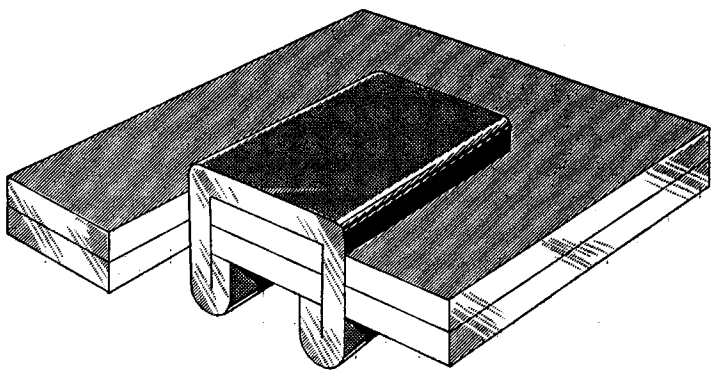


8 PAINTED BAND

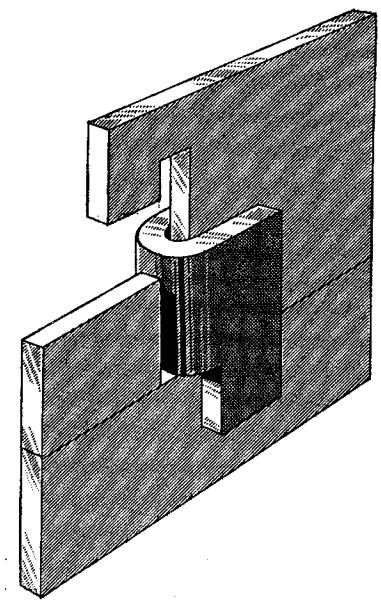
8 Interlocking Sheetmetal Fasteners

These eight sheetmetal parts join sheetmetal quickly with the simplest of tools, few screws or bolts.

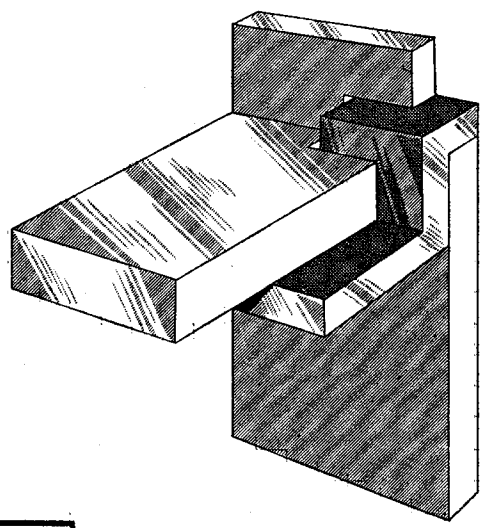
L. Kasper



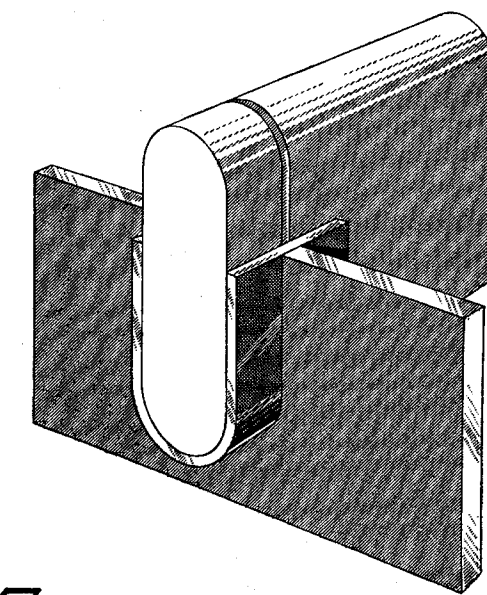
1 **SQUEEZE CLIP** holds two overlapping sheets together. The ends of the clip are pushed through parallel slots, then bent over much like a staple.



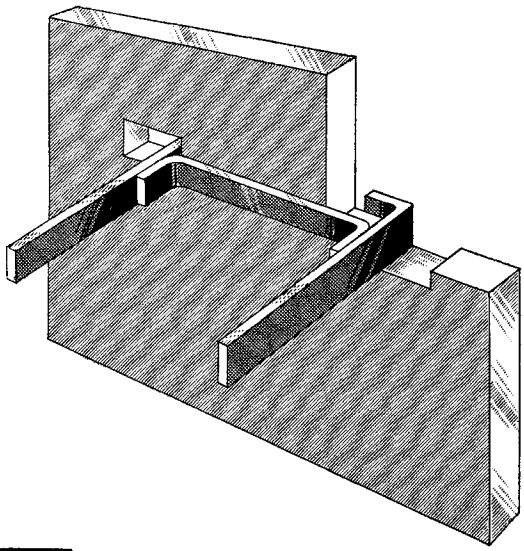
2 **ALIGNING PIECE** slides up out of the way in long slot while butting sheets are being positioned. Afterwards it slips down over lower sheet.



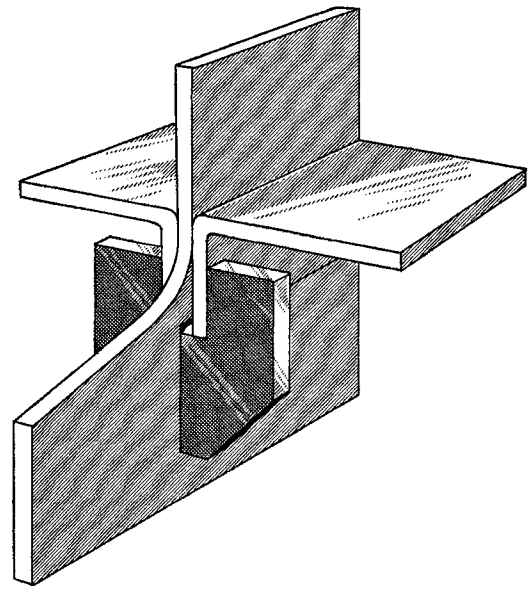
5 **ESS** supports shelf between uprights. By mating with notched edge it acts as a key to keep shelf from sliding back and forth and provides positive location.



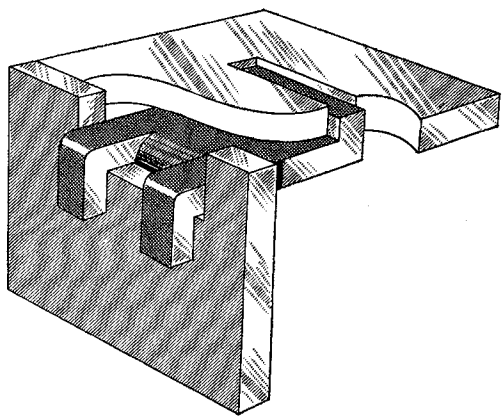
6 **CUP** carries a bar on both sides of divider. Here bars stick up above the top, but deeper cutout will lower them until they are flush or sunk.



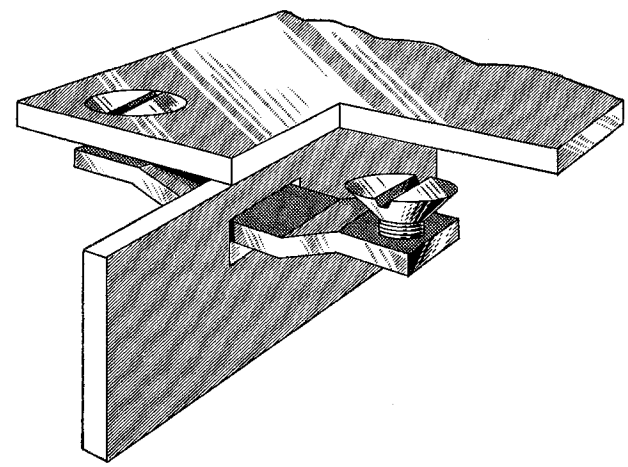
3 **BRACKETS** provide instantly mobile rack space for boxes. To install or remove, squeeze sides together and push hooked ends through slots.



4 **FLANGE HOLDER** does double duty by holding up shelves on both sides of a partition. Angular corners allow it to fit through small slit when tilted.



7 **CLAW** holds top sheet between two end pieces. Tail snaps into slot, then claw is hammered over edge. With notched edge, top is even with sides.

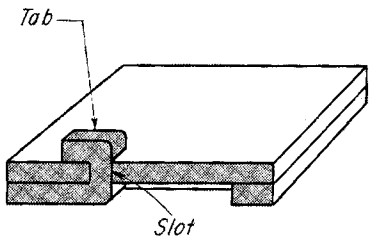


8 **BAR** clamps divider in place. Extruded holes provide a recess for screws so that they stay flush with upper surface of horizontal sheet.

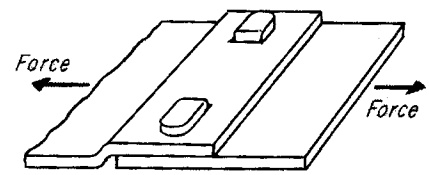
Lanced Metal Eliminates Separate Fasteners

15 ways in which sheetmetal tabs, ears and lugs can serve to fasten and locate.

Federico Strasser

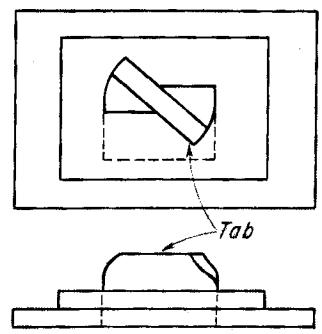


1

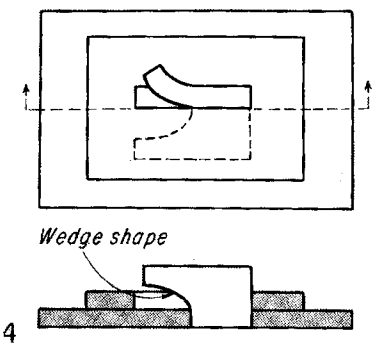


2

BENT-OVER TAB holds together up to four layers of sheetmetal. Designing tabs to stress in shear increases holding strength.

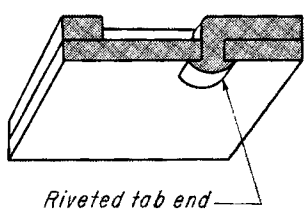


3



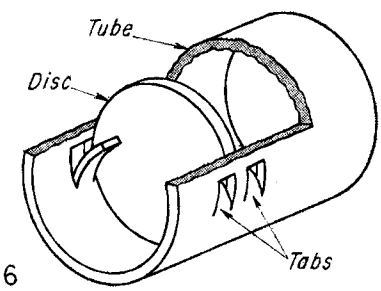
4

TWISTED TAB is less common than bent one. Shaped tab wedges tightly when twisted.

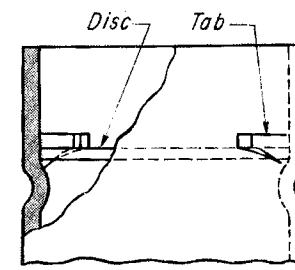


5

WITH THICK STOCK, end of tab can be riveted.

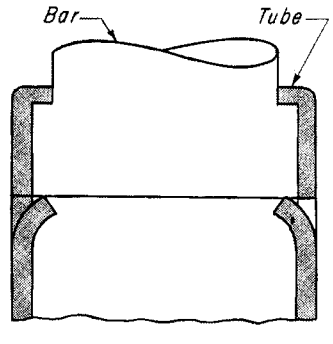


6

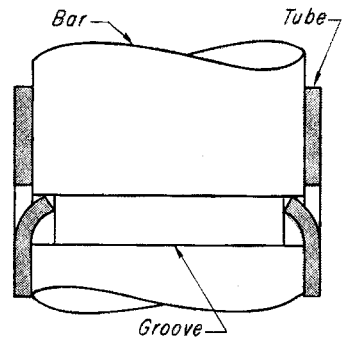


7

THESE TABS both locate and hold disk in tubing. When necking locates disk, tab only holds—again by wedge action.

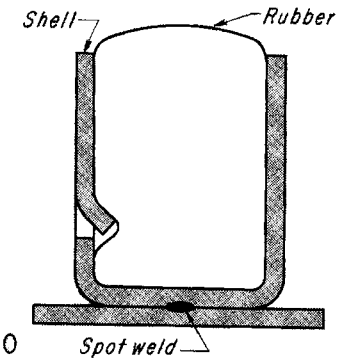


8



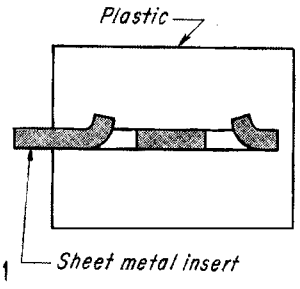
9

LIP AND TABS combine to join round bar and tubing. For longer bars, tabs fit into grooves. Bar can rotate inside tube if tabs are pressed lightly into groove.

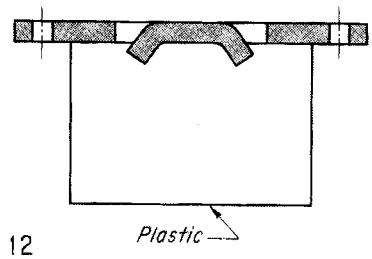


10

LANCED SHELL secures rubber in bumper or instrument foot.

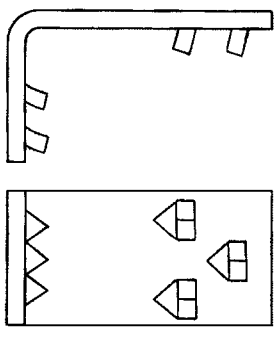


11



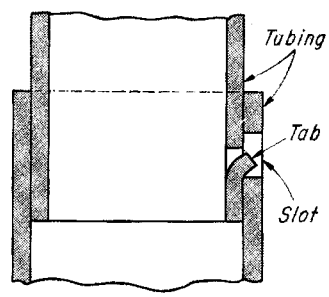
12

METAL REINFORCEMENTS and mounting pads grip plastic better if lanced.



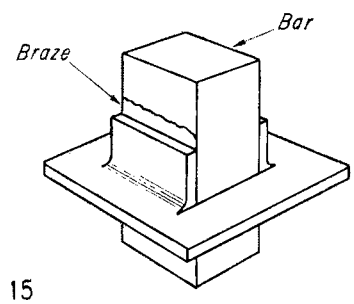
13

CORNER REINFORCEMENT grips wood, plastic or fiber with lanced teeth. Similarly, lanced nameplates or labels attach easily to equipment or instrument panels by pressing into the surface.



14

INTERLOCKING SLOT and tab connects two pieces of tubing. Joint is permanent if inner tubing has thick wall. If inner tube has thin wall, tab can be depressed and tubes pulled apart if desired.

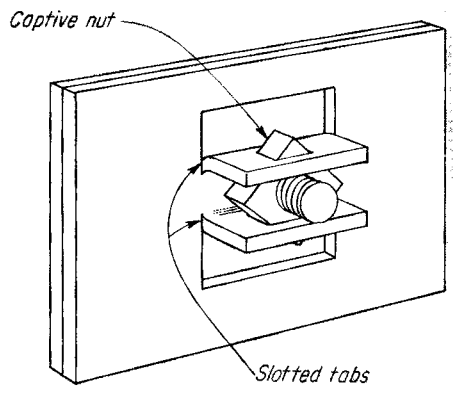


15

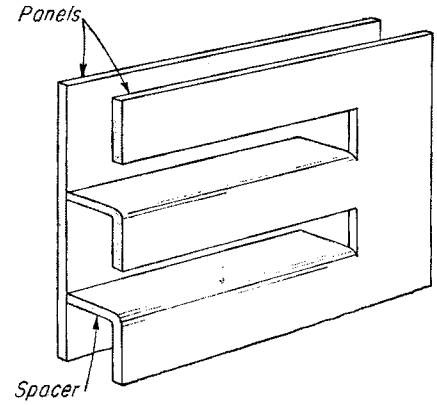
LANCED FLAPS provide large contact areas for brazing or soldering sheet-metal fins to bars and pipes. An alternate method for round bars or pipe is an embossed collar around the hole. However, for angular shapes, flaps are easier to make.

Lanced Sheetmetal Parts

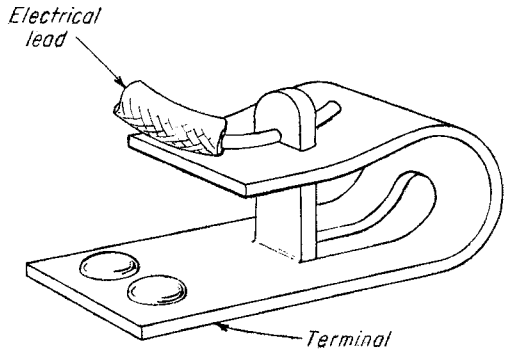
Federico Strasser



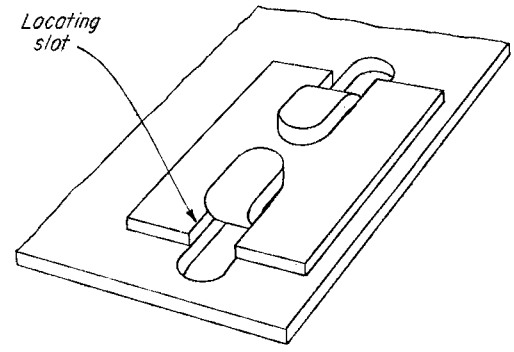
1 CAPTIVE NUT allows blind assembly on panel too thin to tap. Nut is held firmly, cannot get lost.



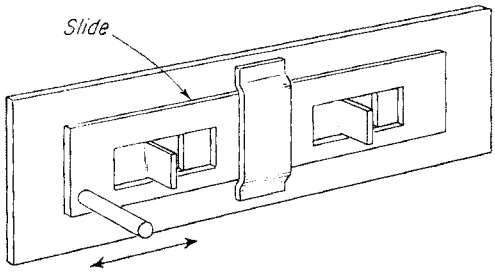
2 SPACERS separate panels with fewer parts and with less weight than extra strips or filler materials.



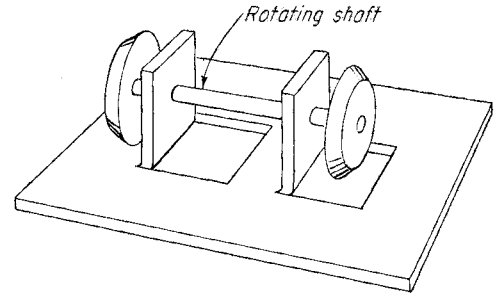
3 TERMINAL made of flat spring stock presses wire lead tightly in lanced tab, yet releases easily.



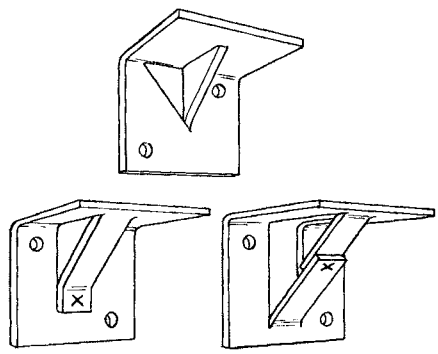
4 TABS fit into slot to align in one direction as well as fasten. Matching tab and slot on other side would align plate in second direction.



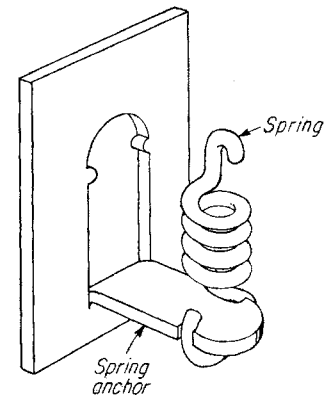
5 SLIDE rides on projecting tabs. At same time, tabs act as limit stops. Length of slot determines how far the slide can travel.



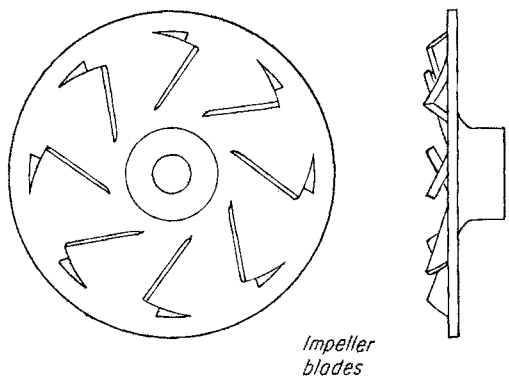
6 RAISED TABS are bearings and supports for rotating shaft in light-duty applications. Tabs will also guide sliding rod or bar. Bent-up end of plate can take place of a tab.



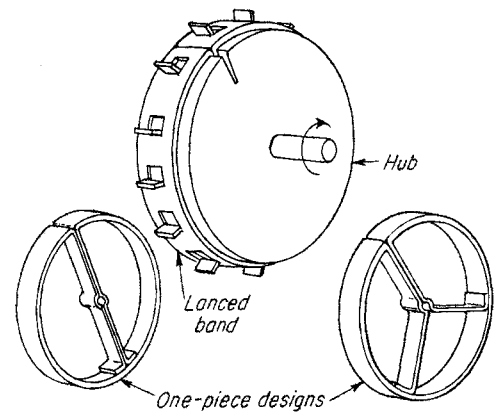
7 REINFORCEMENT RIBS of three different designs all give support for wall bracket, yet retain one-piece construction.



8 SPRING ANCHOR—possible variations: tab with hole, or tab with only one notch for spring that pulls to side.



9 LANCED BLADING results in one-piece construction of lightweight cooling fan for small motors.



10 CONTINUOUS STRIP is lanced while flat, then cut to length and rolled into a sprocket. Small sketches suggest ways to avoid a separate hub.

Joining Circular Parts without Fasteners

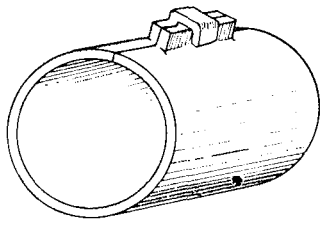


Fig. 1—Fastening for a rolled circular section. Tabs are integral with sheet; one tab being longer than the other, and bent over on assembly.

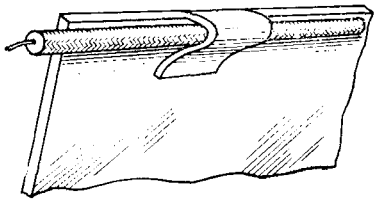


Fig. 5—Similar to Fig. 4 for supporting electrical wires. Tab is integral with plate and crimped over on assembly.

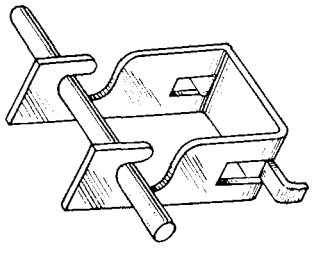


Fig. 6—For supporting of rods or tubes. Installation can be either permanent or temporary. Sheet metal bracket is held by bent tabs.

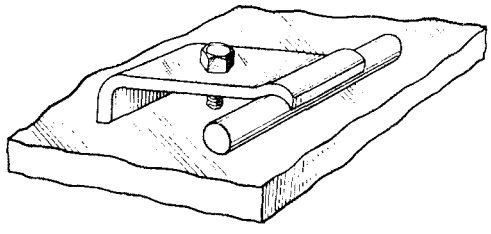


Fig. 7—Embossed sheet metal bracket to hold rods, tubes or cables. Tension is supplied by screw threaded into lower plate.

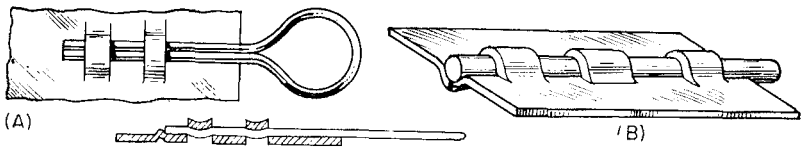


Fig. 10—Plate is embossed and tabs bent over on assembly. If two plates are used having tab edges (B) a piano-type hinge is formed. (A) and (B) can be combined to form a quick release door mechanism. A cable is passed through the eye of the hinge bolt, and a handle attached to the cable.

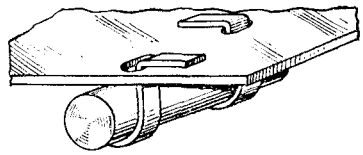


Fig. 11—Rods and tubes can be supported by sheet metal tabs. Tab is wrapped around circular section and bent through plate.

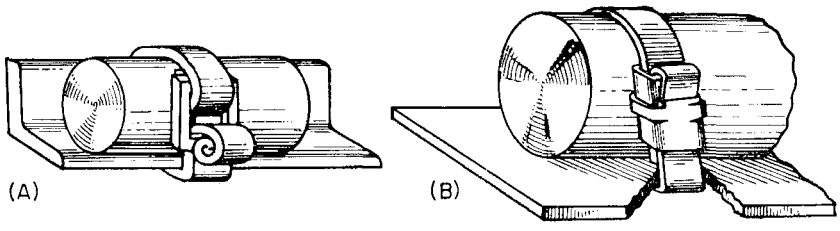


Fig. 14—Strap fastener to hold a circular section tight against a structural shape. Lock can be made from square bar stock (A) or from sheet metal (B) tabbed as shown. Strap is bent over for additional locking. Slotted holes in sheet should be spaced equal to rod dia to prevent tearing.

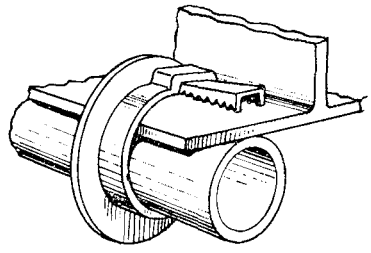


Fig. 15—*C* clamp support usually used for tubing. Serrated wedge is hammered tight; serrations keep wedge from unlocking.

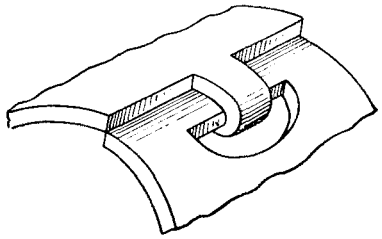


Fig. 2—Similar to Fig. 1 except tube is formed with a lap joint. Tab is bent over and inserted into cut-out on assembly. Joint tension is needed to maintain lock.

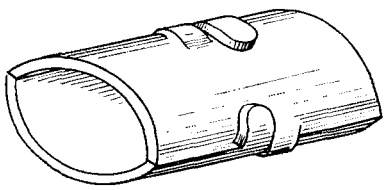


Fig. 3—Tab fastener for elliptical section. Tabs are formed integral with sheet. For best results tabs should be adjacent to each other as shown in sketch above.

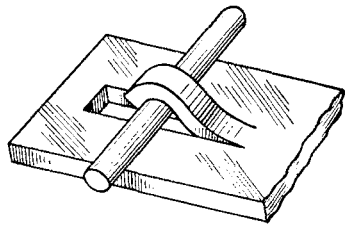


Fig. 4—For supporting rod on plate. Tab is formed and bent over rod on assembly. Wedging action holds rod in place. Rod is free to move unless restrained.

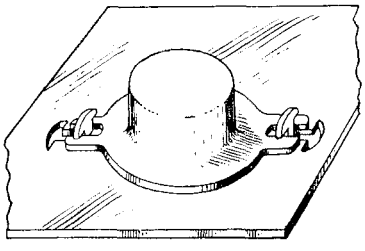


Fig. 8—Fastening of rod to plate. Rod is welded to plate with slotted holes. Tabs in bottom plate are bent on assembly.

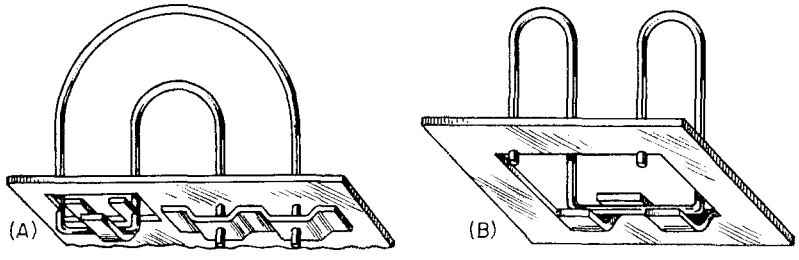


Fig. 9—Tabs and bracket (A) used to support rod at right angle to plate. Bracket can be welded to plate. (B) has rod slotted into place. For mass production, the tabs and slots can be stamped into the sheet. For limited production, the tabs and slots can be hand formed.

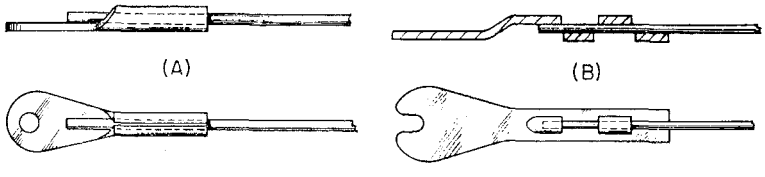


Fig. 12—For connecting wire ends to terminals. Sheet is crimped or tabbed to hold wire in place. Variety of terminal endings can be used. If additional fastening is required, in that parting of the wire and terminal end might create a safety or fire hazard, a drop of solder can be added.

Fig. 13—Spring joins two rods or tubes. Members are not limited in axial motion or rotation except by spring strength.

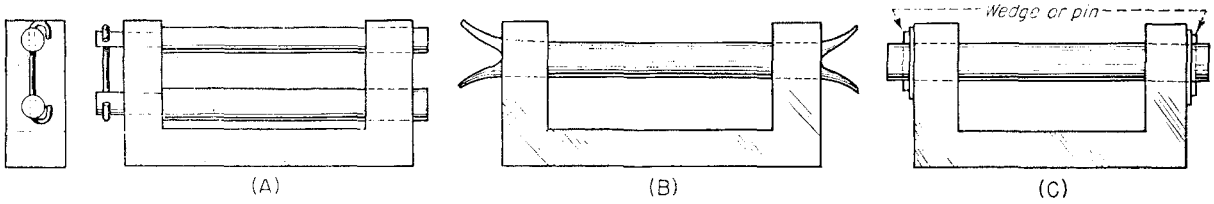


Fig. 16—Methods of locking rods in machine frames. In (A) one end of the rod is machined to a smaller diameter. Shoulder and bent member restrains rod from slipping out of frame. Limited axial and rotational freedom is present. Split rod in (B) limits axial motion but permits rotation. Rod is split on assembly. Wedge or pin in (C) bear against washers. Axial motion can be restricted but rotation is possible. If rod is to be a roller, bearings can be inserted.

Joining Sheet Metal Parts without Fasteners

Methods of attaching rods, tubing and sheet metal parts in permanent or temporary assemblies without using bolts, screws or rivets.

Erwin Rausch

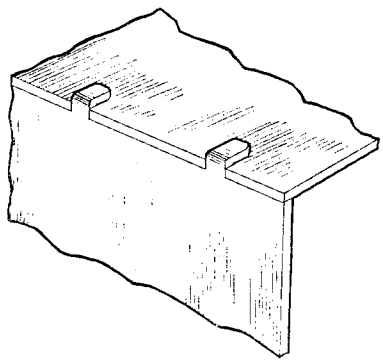


FIG. 1—For butting sheet metal parts at or near a right angle. Two or more tabs are required.

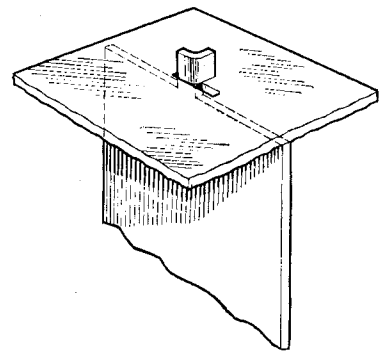


FIG. 2—For applications similar to Fig. 1, but where inaccessibility forbids use of bulky tools.

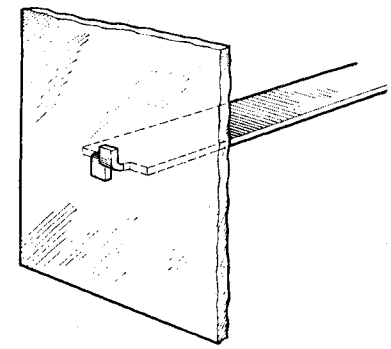


FIG. 3—For use as in Fig. 2, but where greater rigidity is needed.

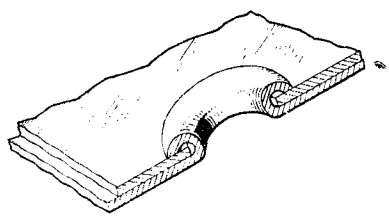


FIG. 4—For permanent attachment of parallel sections. Material must be quarter-hard or softer.

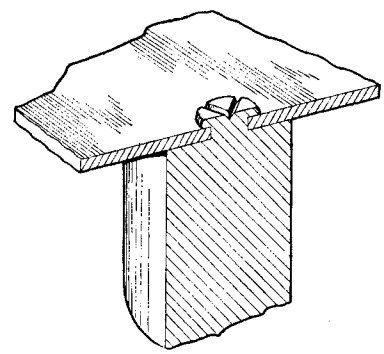


FIG. 5—For positioning shouldered rods in sheet metal. Center-punch as well as "nicking" punch can be used.

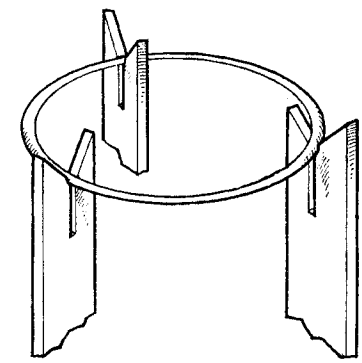


FIG. 6—For temporary support of rods or tubes. Jaws are sprung open during installation and removal.

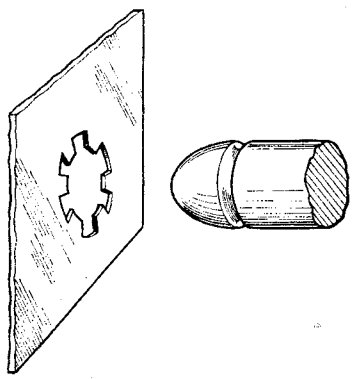


FIG. 7—For semi-rigid attachment. Installation can be permanent or temporary, depending on roundness of rod end and "springiness" of teeth.

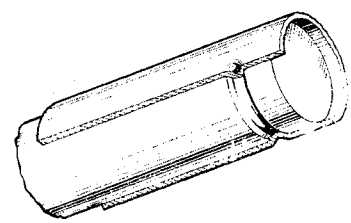


FIG. 8—For permanent location of rod in tube. Dents are made after rod is in place. Axial movement can be obtained by lengthening recess.

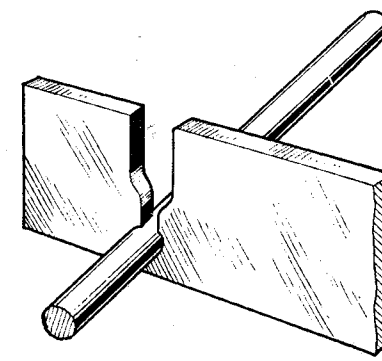


FIG. 9—For temporary positioning of rods in sheet metal. Slots in rod prevent axial movement.

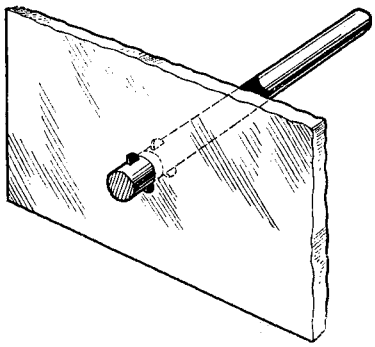


FIG. 10—For permanent assemblies where split forming die can be applied on one or both sides of sheet.

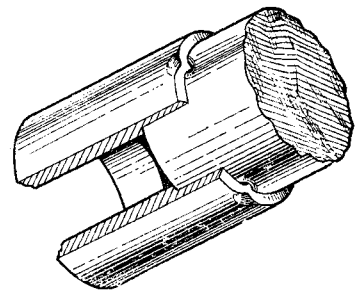


FIG. 11—For attachment of recessed, solid metallic or non-metallic parts in thick-sectioned cylindrical parts.

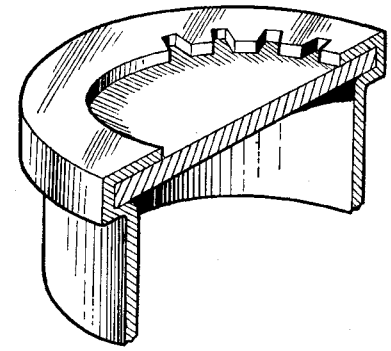


FIG. 12—For closing the end(s) of cylindrical parts. "Toothed" section permits removal of cap, "solid" section does not.

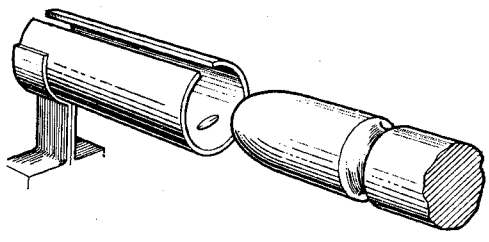


FIG. 13—For bayonet-type electrical fittings. Sleeve and mounting bracket can be modified to suit requirements.

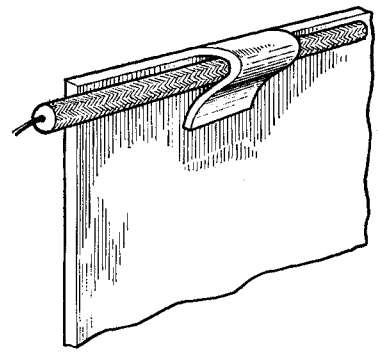


FIG. 14—For supporting electrical conductors.

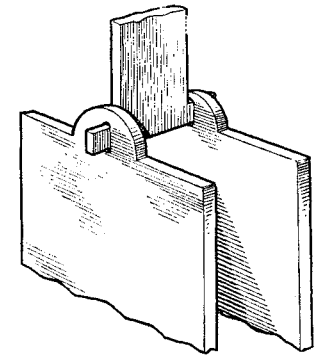


FIG. 15—For permanent assemblies requiring relative movement, but minimum rigidity.

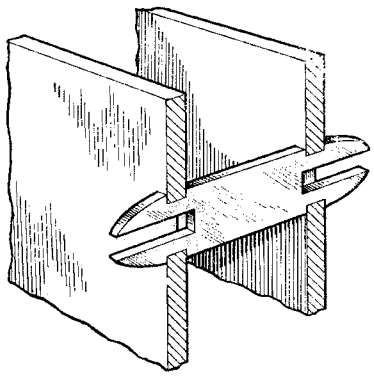


FIG. 16—For temporary use as spacer. Sheet holes can be round or rectangular.

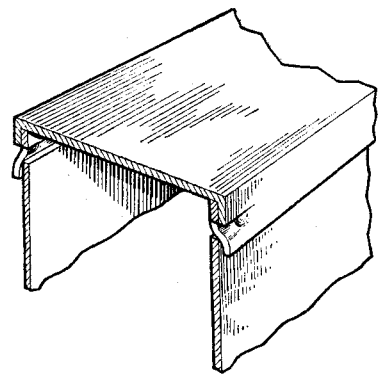


FIG. 17—For attachment of cover to channel or similar assemblies.

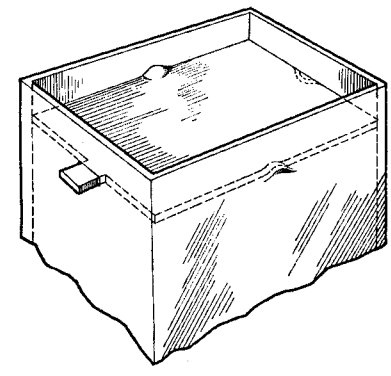


FIG. 18—For recessing sheet metal plates in rectangular housings.

Fastening Sheet-Metal Parts by Tongues, Snaps or Clinching

Detachable and permanent assembly of sheet metal parts without using rivets, bolts or screws.

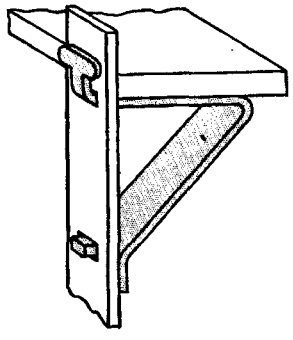


Fig. 1—Supporting bracket formed from sheet metal and having integral tabs. Upper tab is inserted into structure and bent. Ledge weight holds lower tab.

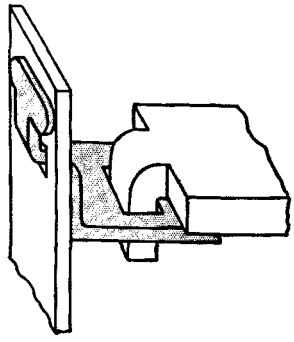


Fig. 2—Supporting bracket similar to Fig. 1 but offering restraint to shelf or ledge. Tabs are integral with sheet metal part and are bent on assembly.

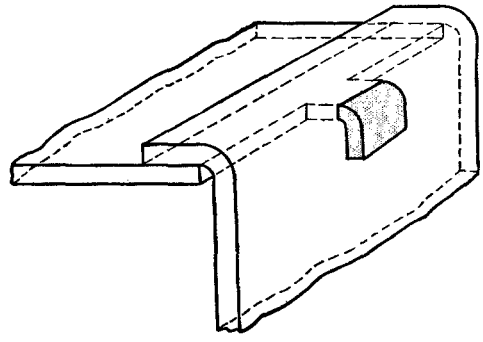


Fig. 3—Supporting ledge or shelf by direct attachment. Tab is integral and bent on assembly. Additional support is possible if sheet is placed on flange and tabbed.

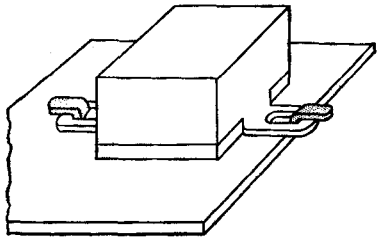


Fig. 7—Box section joined to a flat sheet or plate. Elongated holes are integral with box section and tabs are integral with plate. Design is not limited to edge location.

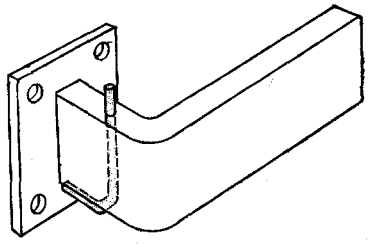


Fig. 8—Bar is joined to sheet metal bracket by a pin or rod. Right angle bends in pin restrict sidewise or rocking motion or bar. Bracket end of pin is peened.

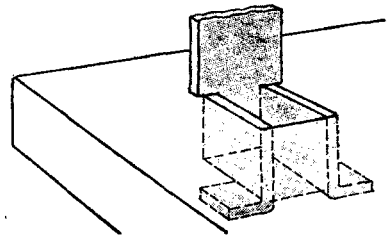


Fig. 9—To support and join sheet metal support at right angle to plate. Motion is restricted in all directions. Bottom surface can be grooved for tabs.

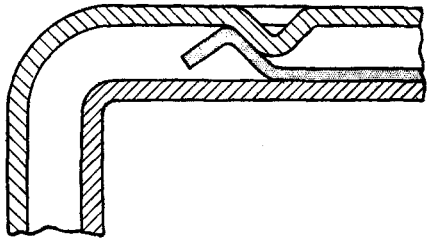


Fig. 13—A spacing method that can be used for circular sections. Formed sheet metal member support outer structure at set distance. Bead centers structure.

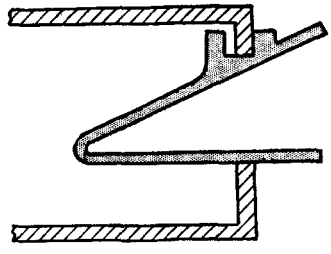


Fig. 14—A removable section held in place by elasticity of material. Design shown is a temporary or a removable cover for an elongated slotted hole in a sheet metal part.

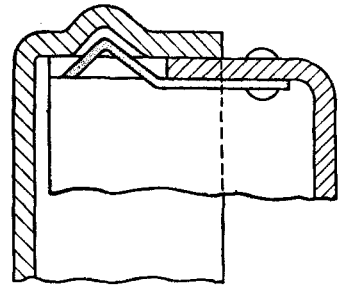


Fig. 15—A cover held in position by bead and formed sheet. Cover is restrained from motion but can be rotated. Used for covers that must be removable.

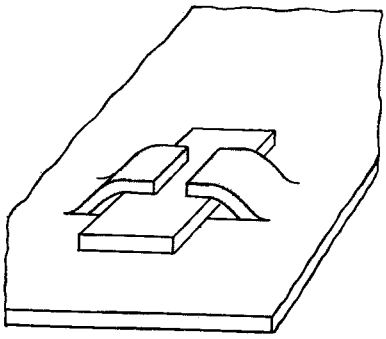


Fig. 4—To support or join a flat sheet metal form on a large plate. Tabs are integral with plate and bent over on assembly. Only sidewise motion is restricted.

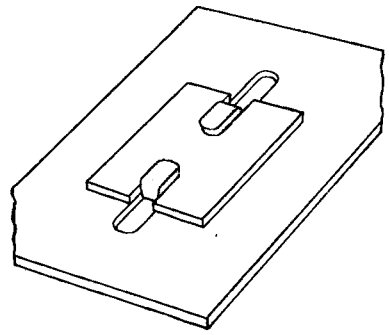


Fig. 5—Similar to Fig. 4 but motion is restricted in all directions. Upper sheet is slotted, and tabs are bent over and into slots on assembly.

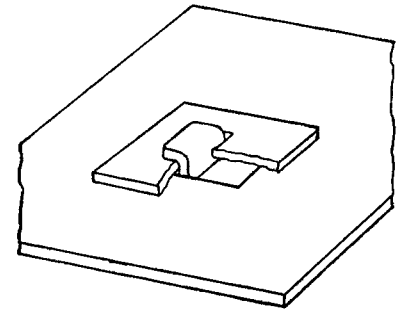


Fig. 6—Single tab design for complete restriction of motion. Upper plate has an elongated hole that matches width and thickness of integral lower plate tab.

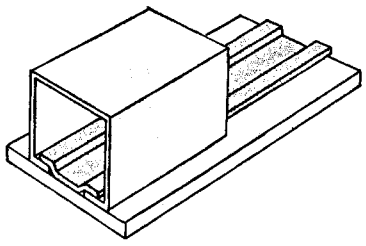


Fig. 10—Channel section spot welded to plate forms bottom surface and joins box section to plate. Channel edges can be crimped or spot welded to restrict motion.

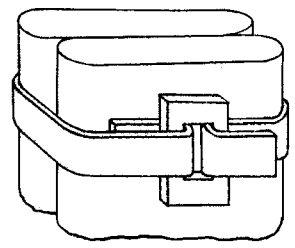


Fig. 11—Sheet metal strap used to join two flat surfaces. Edges of plate are rounded to allow strap to follow contour and prevent cutting of plate by the metal strap.

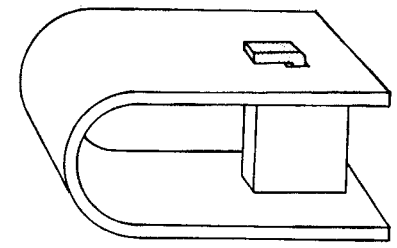


Fig. 12—Sheet metal structures can be spaced and joined by use of a tabbed block. Formed sheet metal U section is held to form by the block as shown.

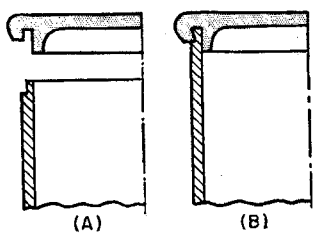


Fig. 16—A non-removable cover design. The vessel is notched as shown in A, and the cover crimped over, B, on assembly. This is a permanent cover assembly.

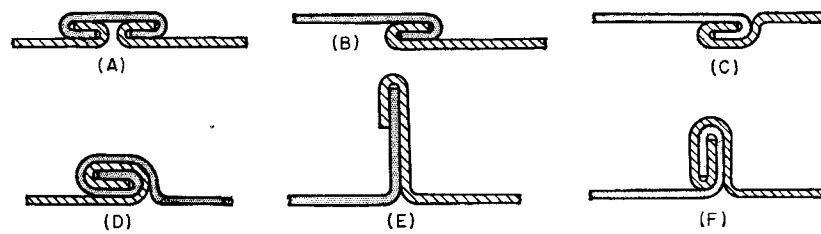
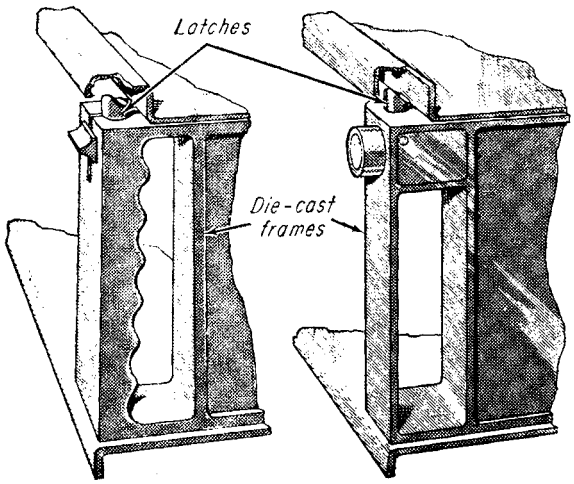


Fig. 17—Six methods of joining two sheet metal parts. These can be temporary or permanent joints. If necessary, joints can be riveted, bolted, screwed or welded for added strength and support. Such joints can also be used to make right angle corner joints on sheet metal boxes, or for attaching top and bottom covers on sheet metal containers.

Retainers for Circuit Boards

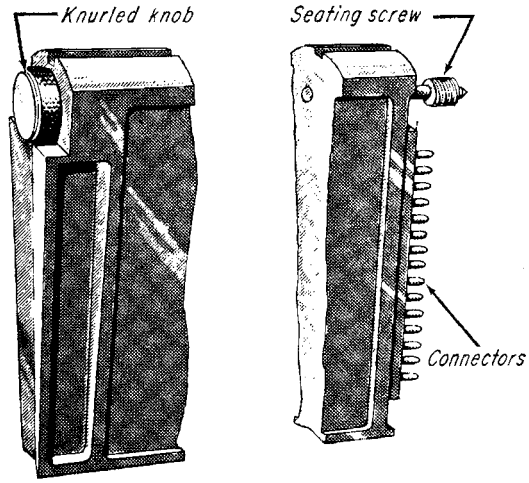
These retainers ensure that the board is properly seated and locked against shock and vibration.

Irwin N. Schuster



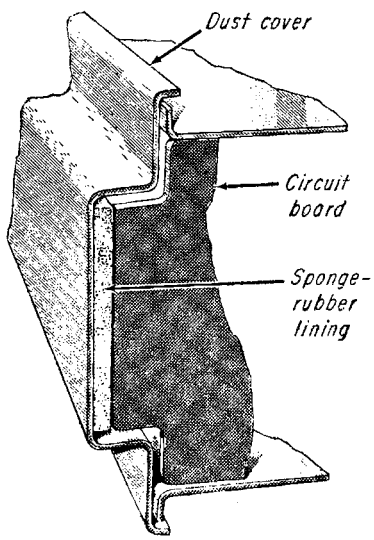
1

SPRING-LOADED LATCHES for large die-cast frames are positive and clean looking. The cost is somewhat high.



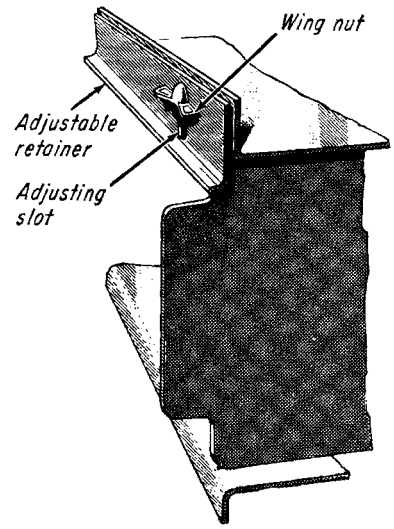
2

TIGHT SEATING is necessary for connectors of the plug and socket type. A screw and a knurled knob aid seating.



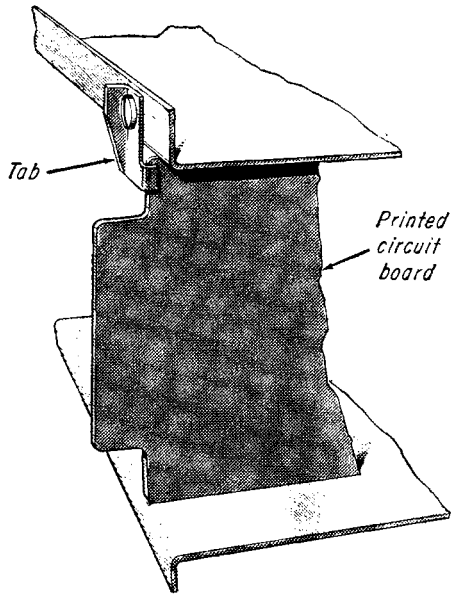
5

DUST COVER, lined with sponge rubber, does double duty – it holds the board in place and helps protect it from shock.

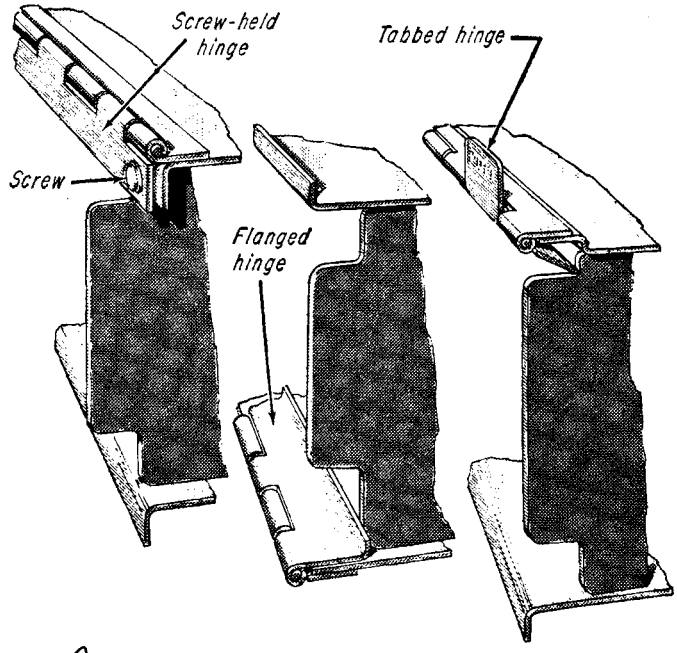


6

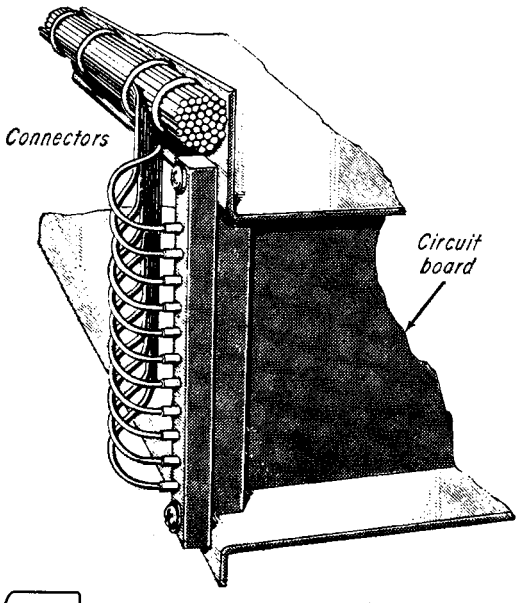
ADJUSTABLE PLATES, either flat or formed, are very easy to assemble and hold sliding parts firmly in place.



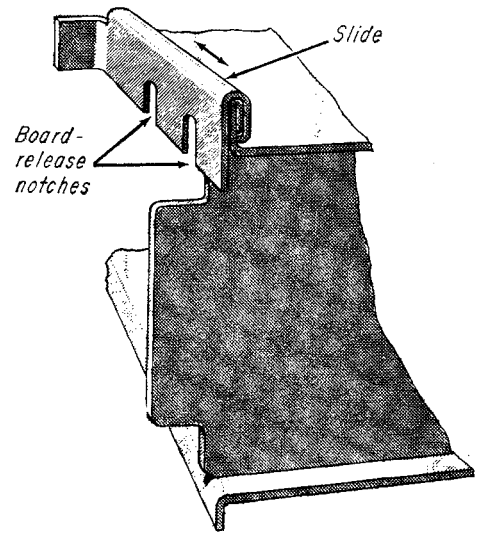
3 **SHEETMETAL TABS,** pivoting on either a shoulder screw or rivet, are always an efficient, low-cost way to retain parts.



4 **HINGES,** spring loaded or otherwise modified, provide a variety of suitable means for retaining circuit boards in place.



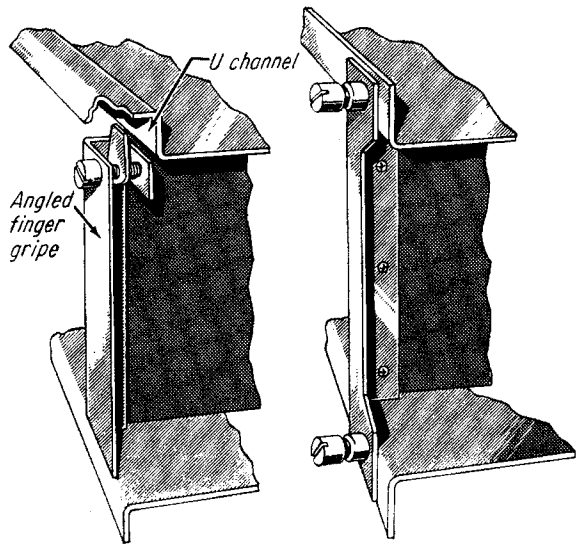
7 **FRONT-MOUNTED CONNECTORS** do double duty here, providing test points for circuit leads and securing the board.



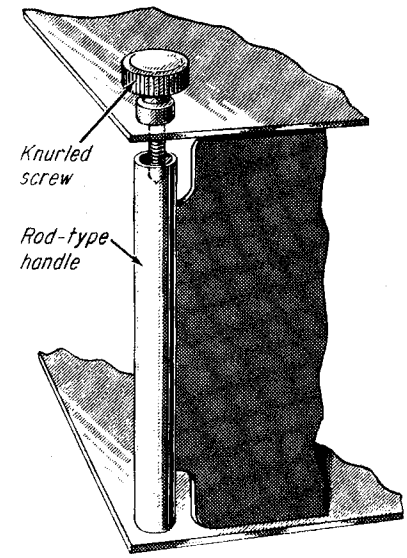
8 **NOTCHES** in the slide provide entrance and exit gates for circuit boards. Lubrication of the slide may be advisable.

These methods for retaining circuit boards can give you some valuable ideas you can apply to other devices.

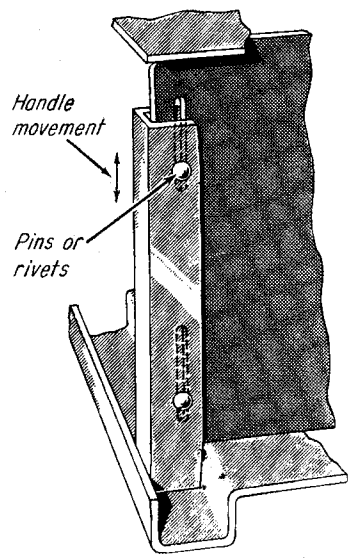
Irwin N. Schuster



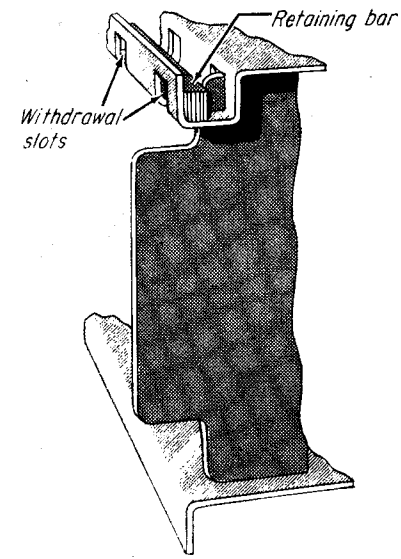
9 **ANGLED HANDLES** fitted with standard hardware parts result in low-cost, yet efficient, slide retainers.



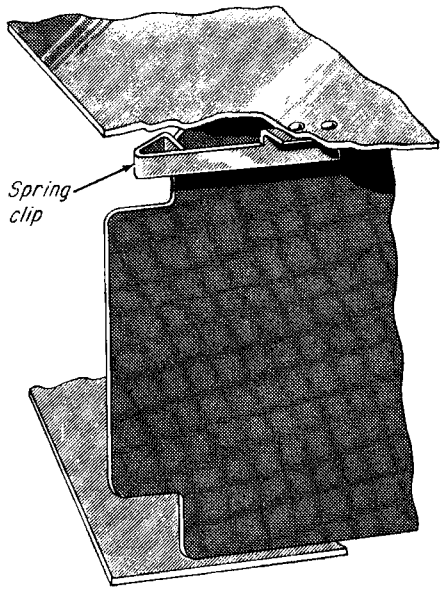
10 **ROD-TYPE HANDLE** can be either solid, with tapped hole for screw, or hollow, with mating dowel-type spring latch.



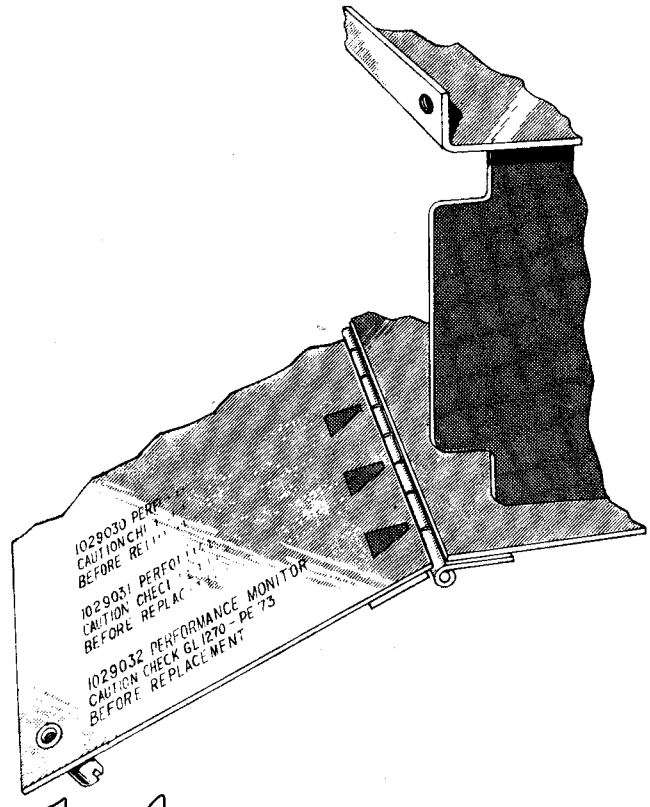
11 **SLIDING HANDLES** can be arranged to fall into locking position when vertical; otherwise they need springs.



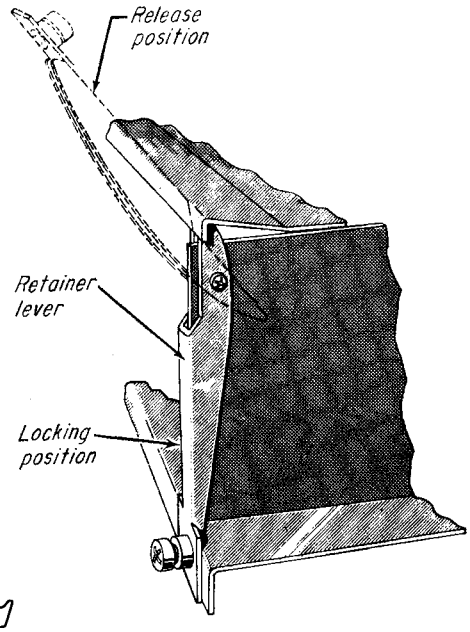
12 **SLOTTED U-CHANNEL** not only locates the circuit boards at correct spacings but also accommodates a retaining bar.



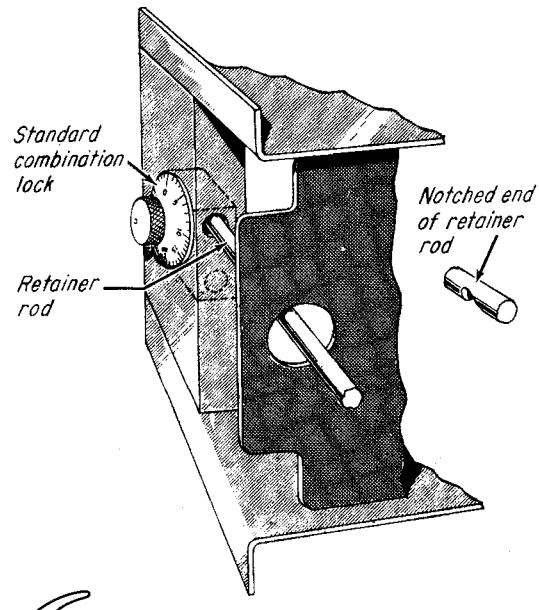
13 **SPRING LATCHES** are always popular for holding parts that must be removed periodically for service.



14 **DOUBLE-DUTY COVERS** not only hold units in place but are also ideal locations for operating instructions.



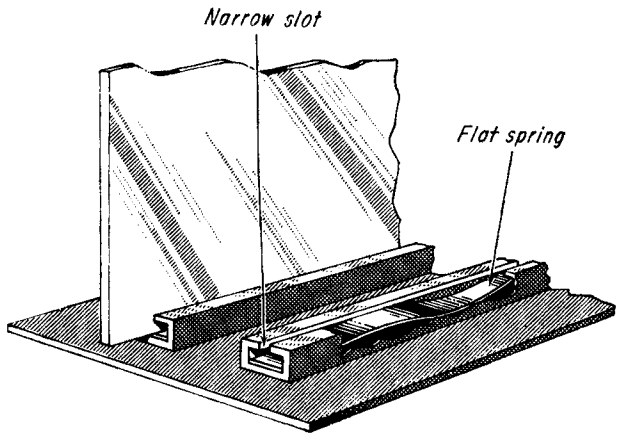
15 **RETAINER LEVERS** jack the boards into and out of the receptacle. Such levers are usually locked in place.



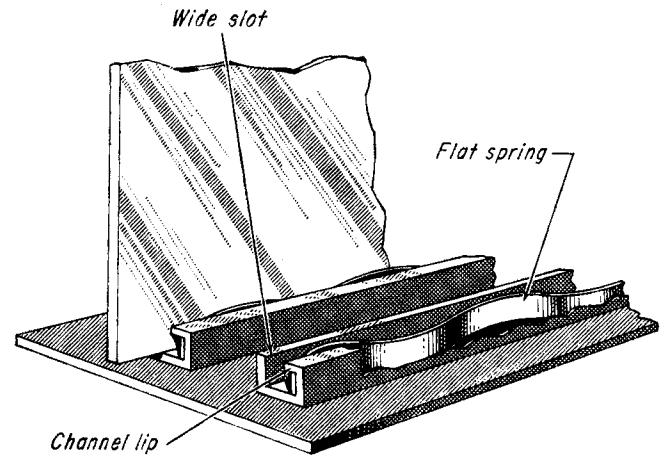
16 **COMBINATION LOCK** and straight, notched bar provide a retaining assembly that is virtually tamperproof.

They allow easy and quick insertion, they guide accurately, and they support the board firmly in place.

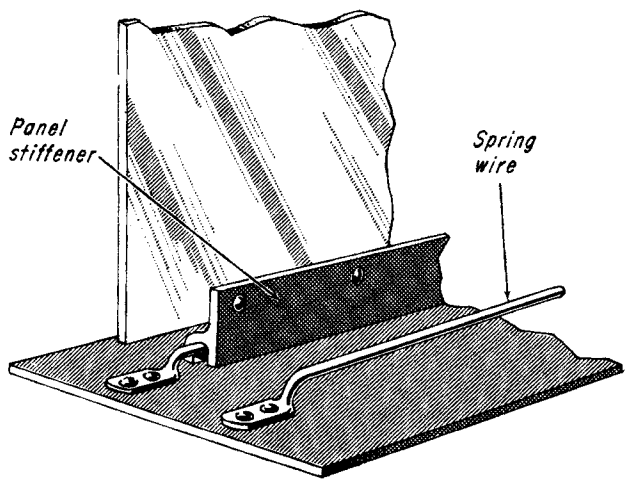
Irwin N. Schuster



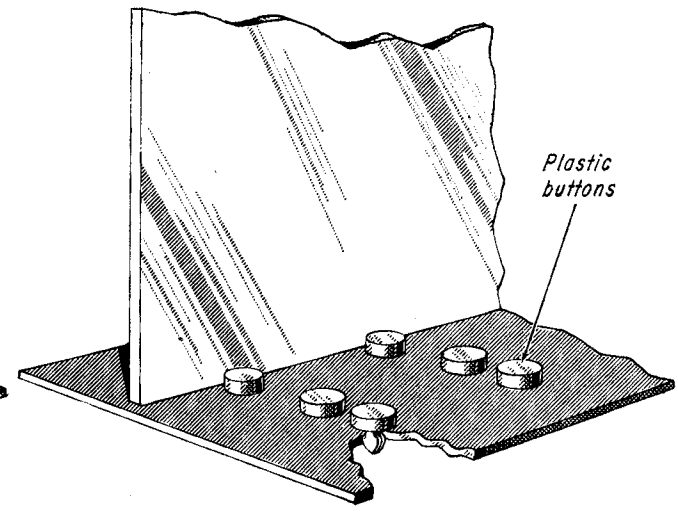
17 **FLAT SPRING** in extruded section provides close limitation for horizontal panel-movement, extreme tolerance vertically.



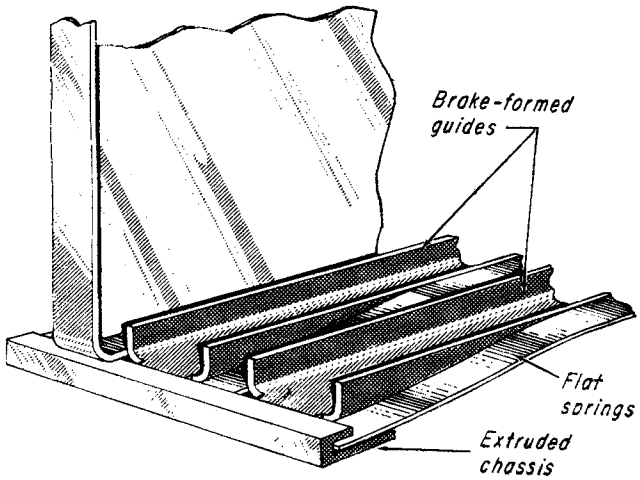
18 **CHANNEL LIP** allows flat spring to be placed to retain circuit board against channel side and reduce tolerances.



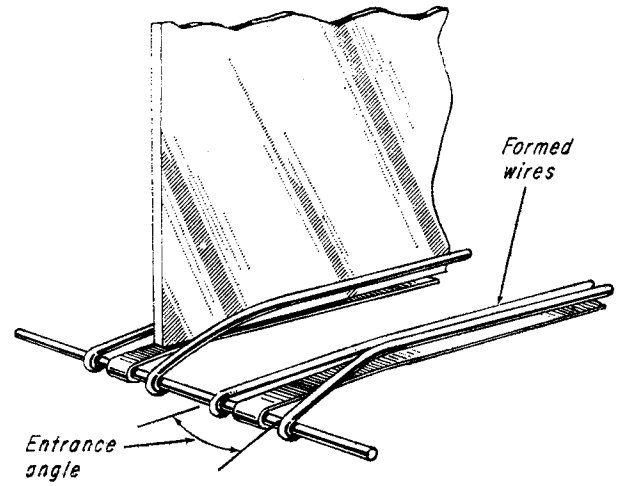
19 **SPRING WIRE** and panel stiffener is a good combination where panel space is not at a premium.



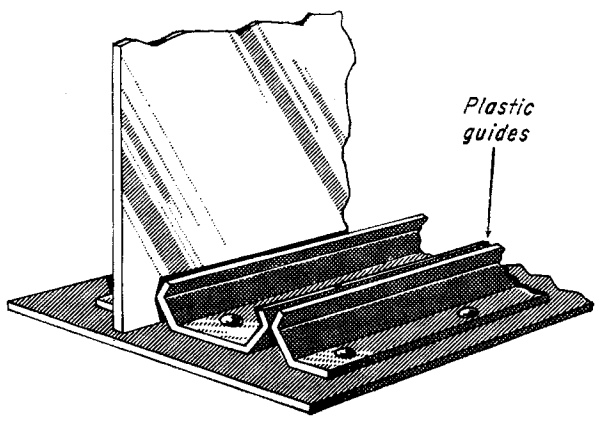
20 **PLASTIC BUTTONS** offer an ultra-simple method of holding panels. The round buttons let panel slide home easily.



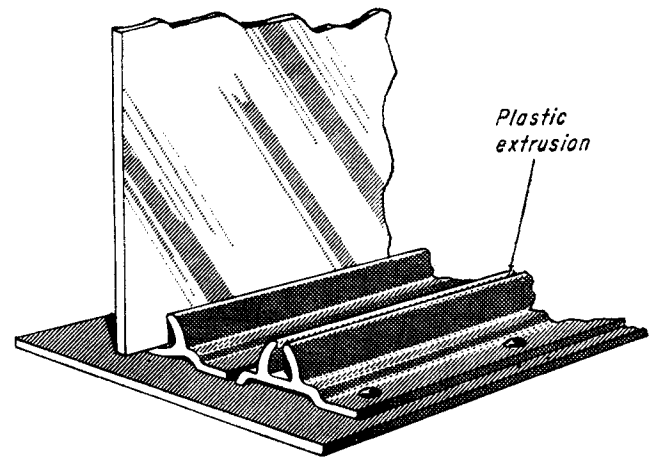
21 **EXTRUDED CHASSIS PARTS,** brake-formed guides, and flat springs allow more tolerance reduction in assembly.



22 **FORMED WIRE** structure lets cooling air through while gripping the circuit board firmly in two planes.



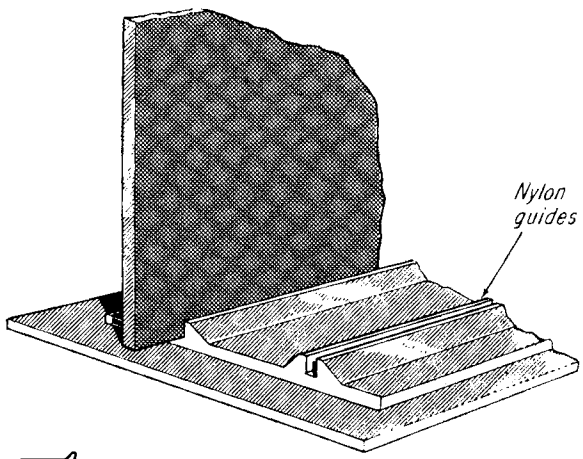
23 **EXTRUDED OR HEAT-FORMED** plastic guides are inexpensive and reduce the chance of shorting to the metal chassis.



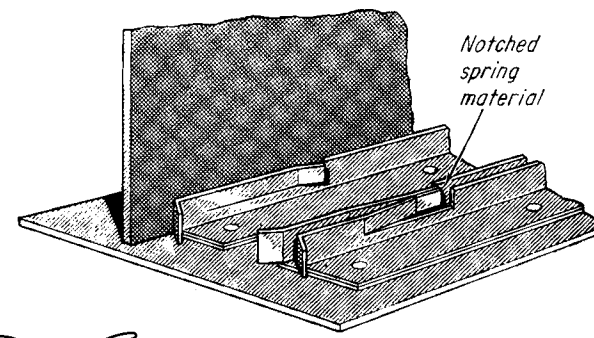
24 **PLASTIC EXTRUSION** here provides its own spring grip to support a light-weight panel in a mild environment.

Printed circuit boards must be easily inserted, accurately guided, and supported firmly in place during service.

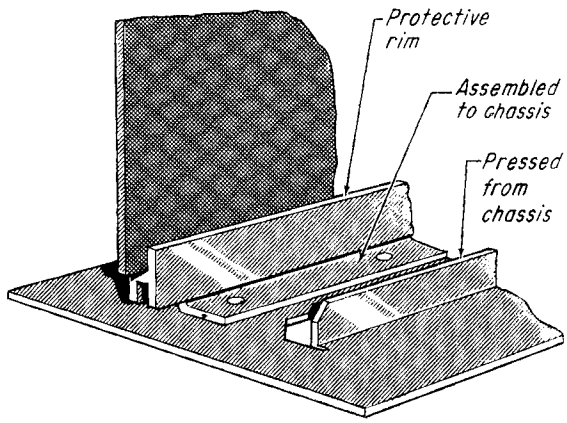
Irwin N. Schuster



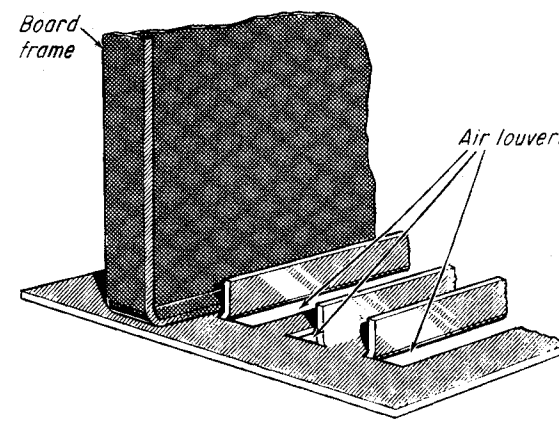
25 **NYLON GUIDES** grip the board along its entire length, lend support, and damp vibration during service.



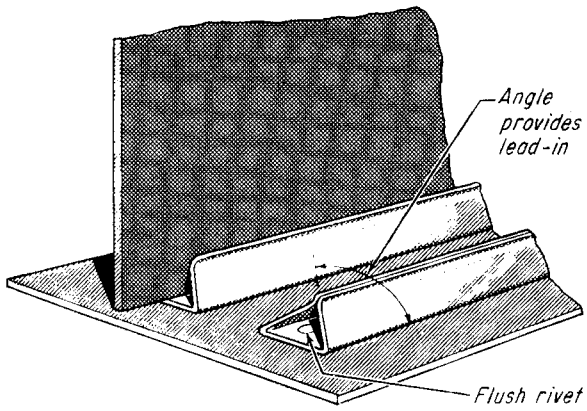
26 **NOTCHED SPRING MATERIAL** allows wide grooves for ease of alignment when mating with fixed connectors.



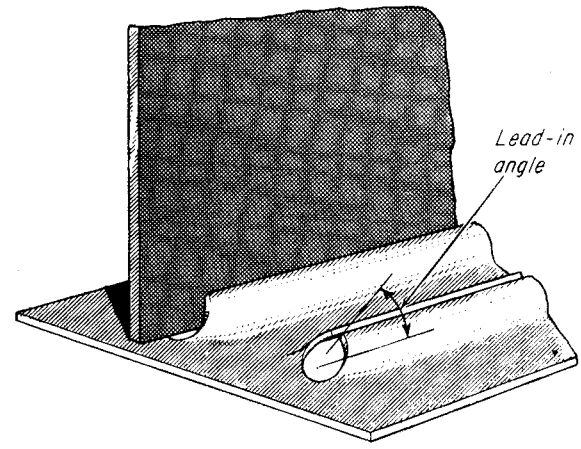
27 **PANEL STIFFENER** and protective rir give excellent service. Guide can b pressed from chassis.



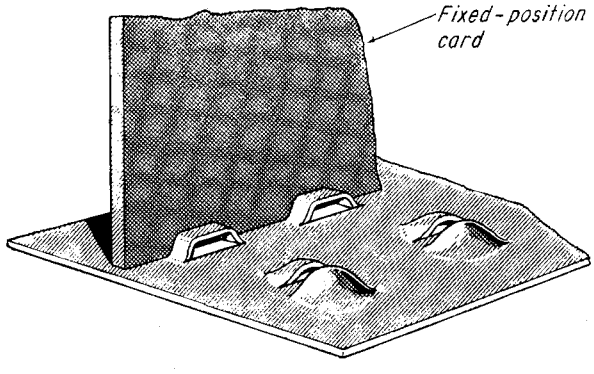
28 **BOARD STIFFENER** requires wide channel in chassis. When channel is pressed from chassis, air louvers are gained.



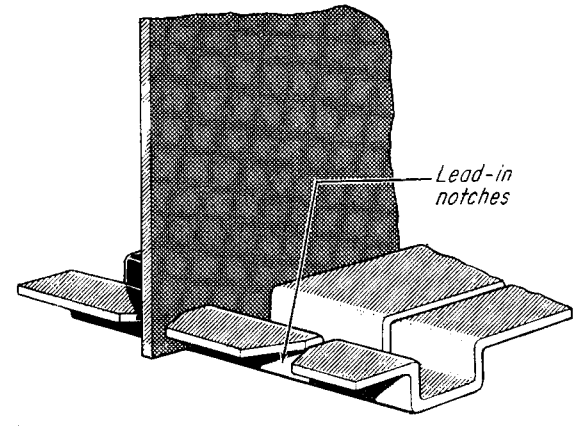
29 **FORMED SHEETMETAL GUIDE** is made of spring material, with the end cut off at an angle to guide the board.



30 **STAMPED-IN** board guide reduces weight of chassis while providing firm board mount. Note lead-in angle.



31 **SMALL SECTIONS** stamped in the chassis provide locating guides for cards mounted in fixed positions.

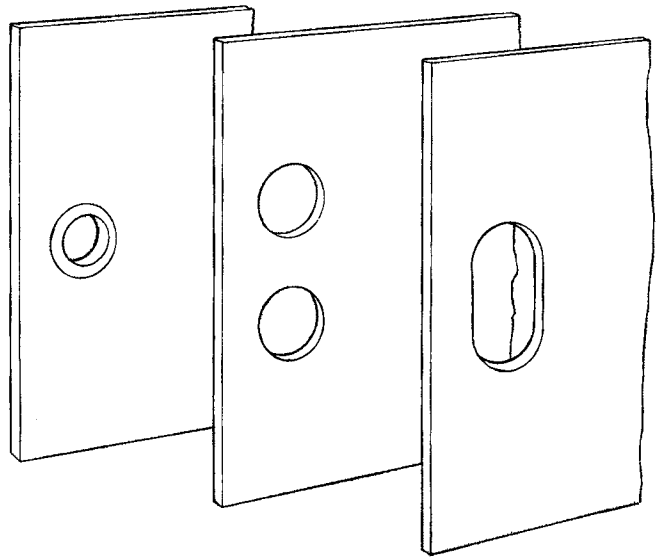


32 **INTEGRAL GUIDE** is ideal when stiff chassis is required and gives excellent lead-in characteristics.

Handles for Printed Circuits

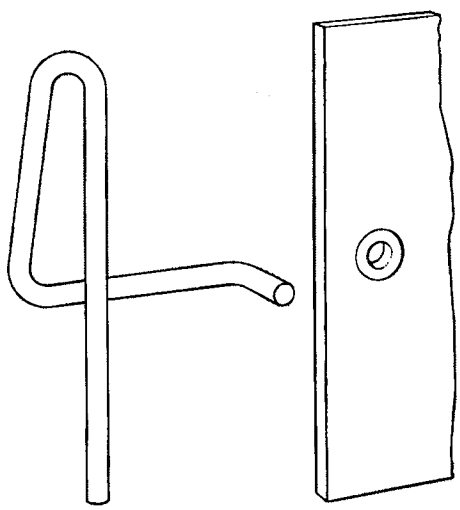
Seven simple designs for making maintenance easier.

Irwin N. Schuster



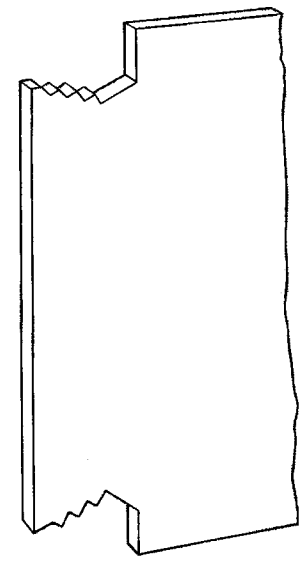
1

PUNCHED OR DRILLED HOLES are adequate if space between boards is sufficient for finger insertion. Grommets may be required in some materials.



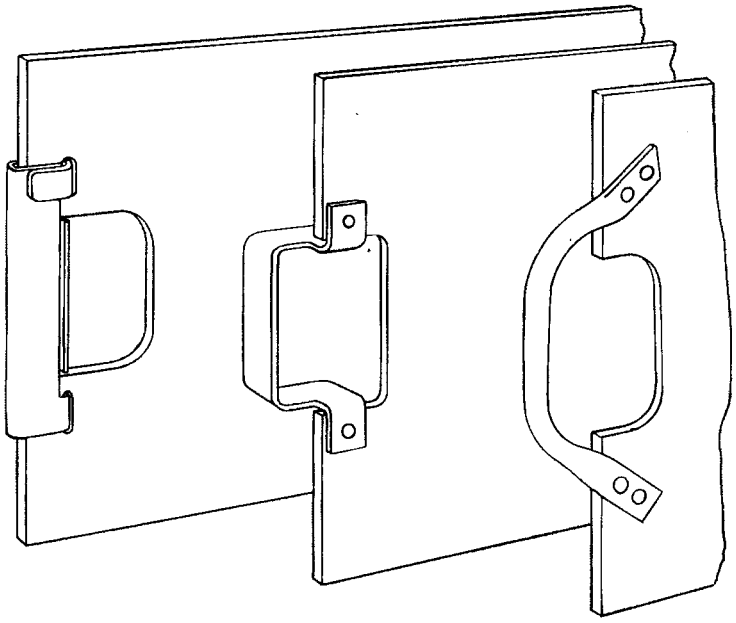
2

SMALL EYELET and removable extractor works well when space and weight are at a premium.



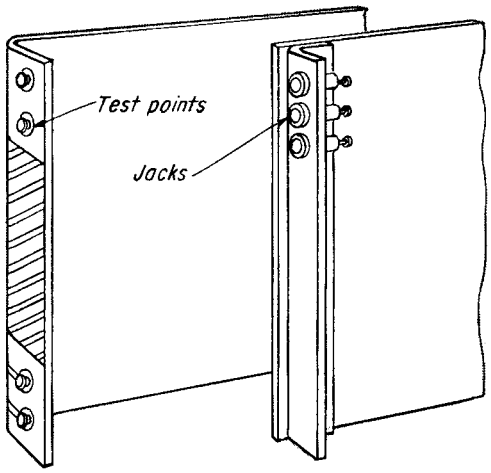
3

SERRATED FINGER GRIPS are often best when spacing of boards is extremely close.



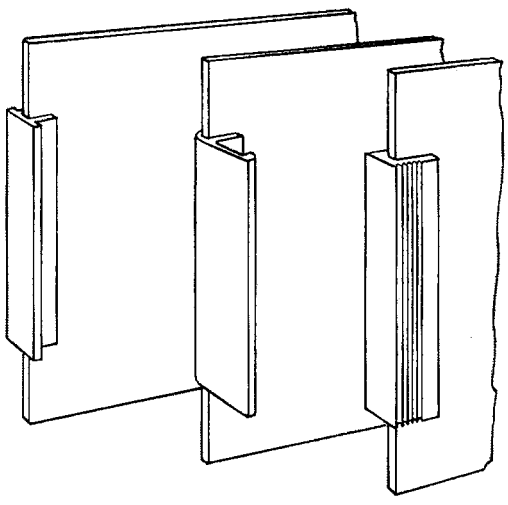
4

INDIVIDUAL HANDLES, tabbed or riveted in place, may be called for on large boards.



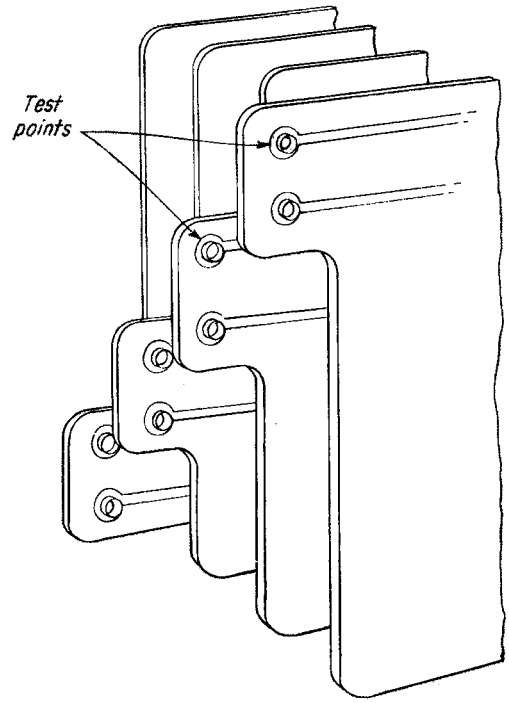
5

FORMED BOARDS do double duty when test points and jacks are incorporated into handles.



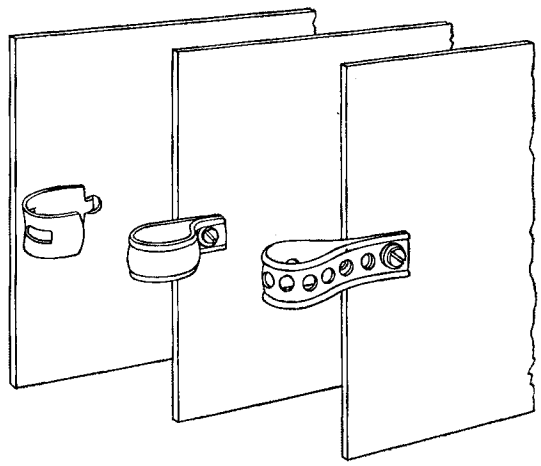
6

EXTRUSIONS staked, crimped or pinned in place form attractive withdrawal aids.



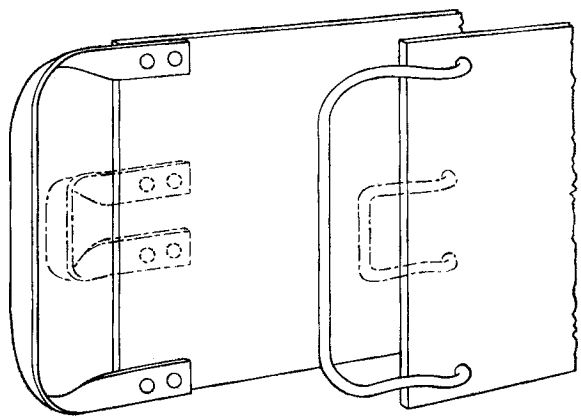
7

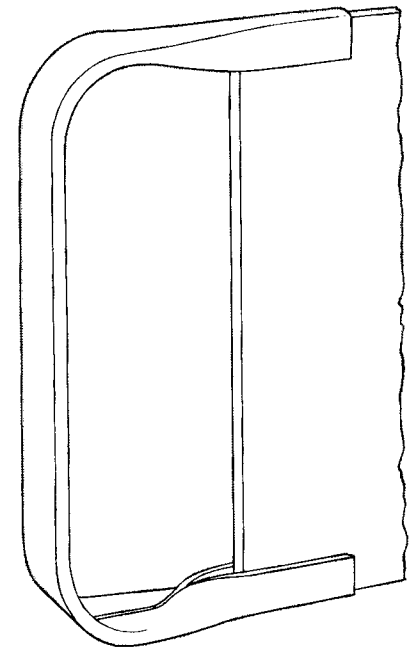
STAGGERED POSITIONS of removal tabs give easy access to test points on closely spaced panels.



8

CABLE CLAMPS AND STRAPS are readily available in many styles. By using solderable materials, handles can be assembled during component-soldering operation.



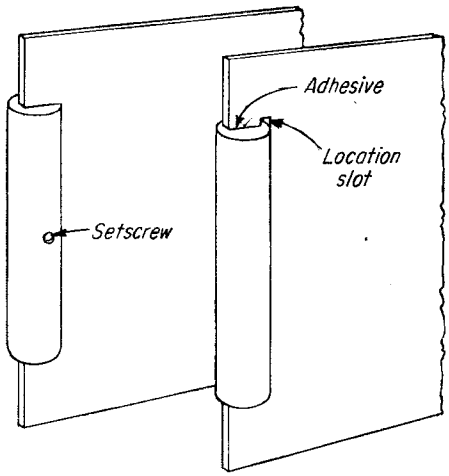


9

MORE COMPLEX SHAPE of sheetmetal handle is often preferred when appearance is an important feature of the design.

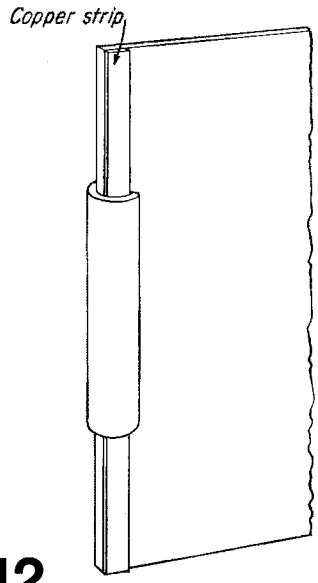
10

WIRE OR SHEETMETAL parts may be easily formed either as full handles or fingergrips.



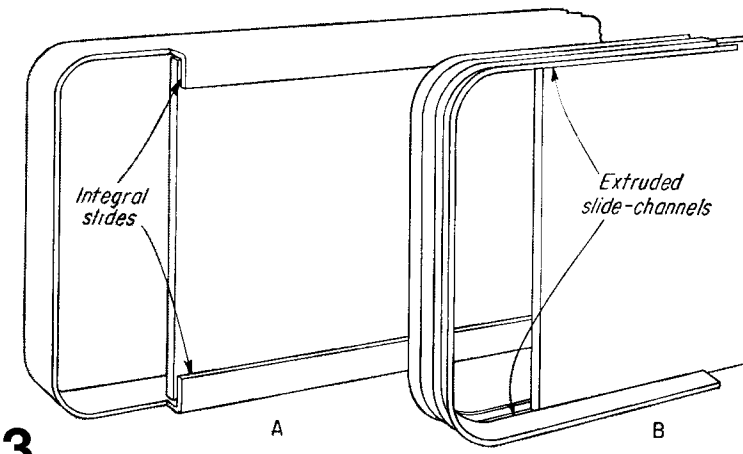
11

SLOTTED ROD, held by either a screw or adhesive, is most suitable when more robust fastening is required.



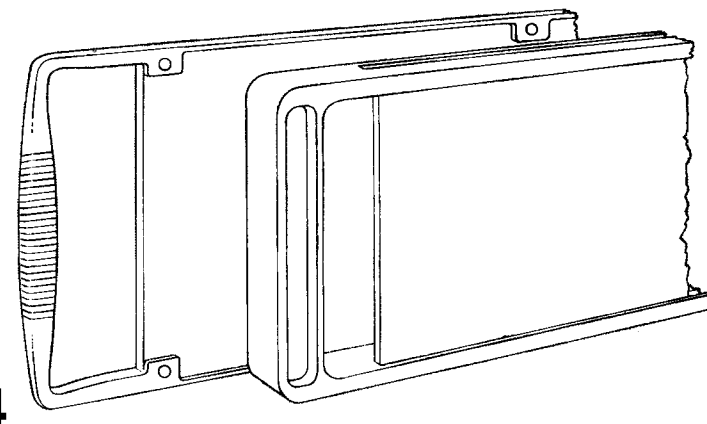
12

SPLIT TUBING can be slipped onto panels and retained by spring effect, or a copper strip can be left to provide a shoulder.



13

BOARD-STIFFENING FRAMES have integral slide surfaces and handles. Method suitable for either press-forming (A) or extrusion (B).



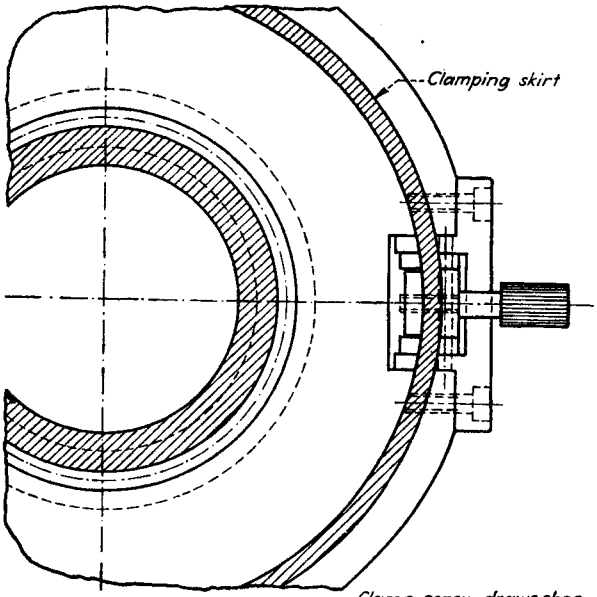
14

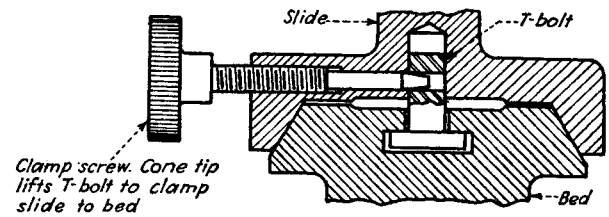
DIE-CAST AND MOLDED handles can be provided if needed in quantity large enough to justify added cost of tooling.

Friction Clamping Devices

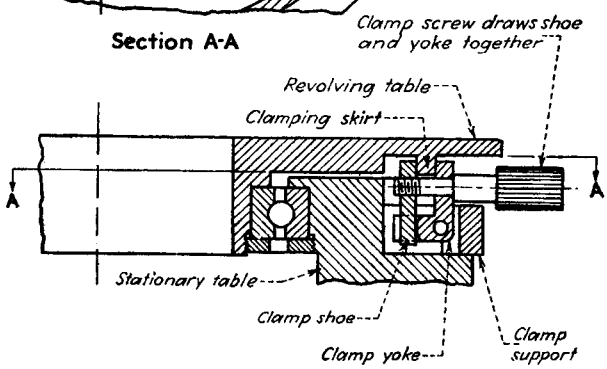
Bernard J. Wolfe

ALL TYPES of mechanisms used for gaining mechanical advantage have probably been used in the design of friction clamps. This type of clamp can hold moderately large loads by friction grip on smooth surfaces even of comparatively small area and, in some designs, tightened or released with little effort and movement of the control. In the clamps illustrated here the mechanical advantage is gained by the use of the common devices: lever, toggle, screw, wedge, and combinations of these means.



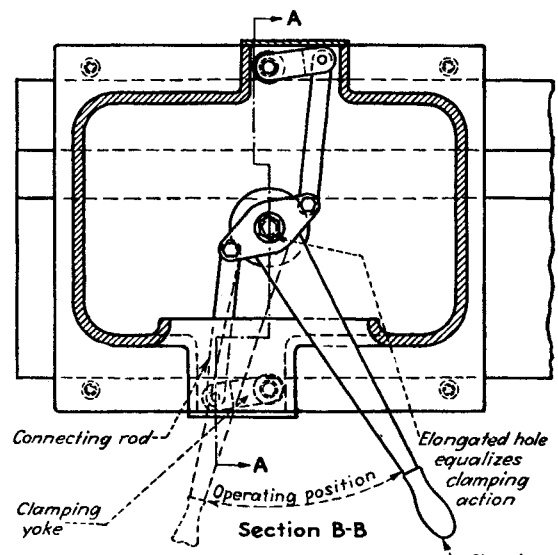


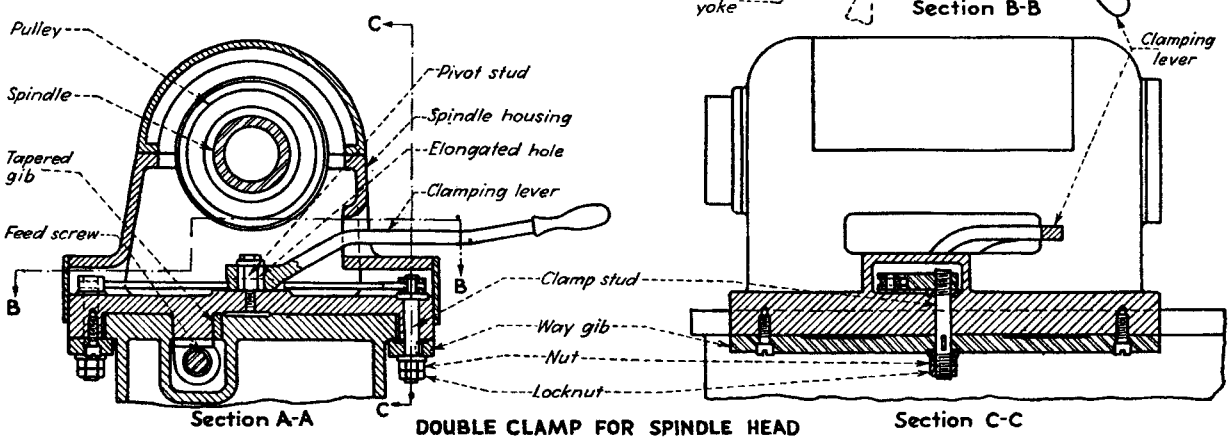
SLIDE CLAMP



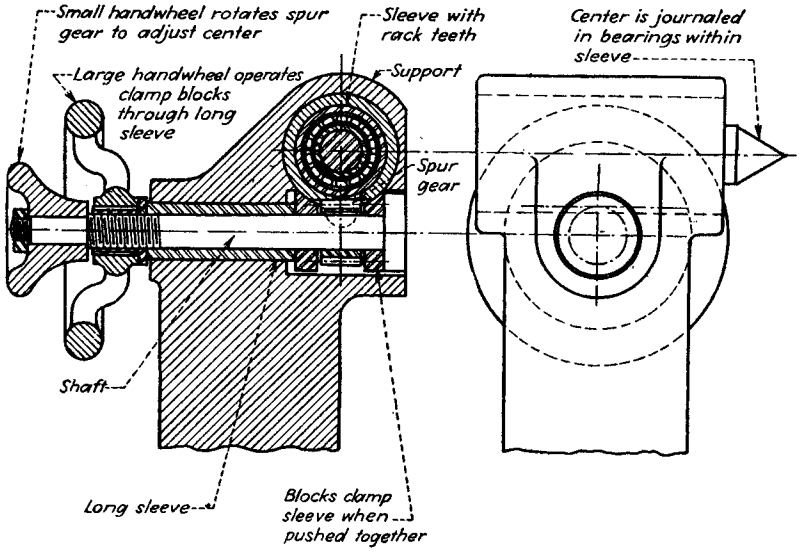
TURN TABLE CLAMP

Clamp assembly floats on pin and does not disturb table setting

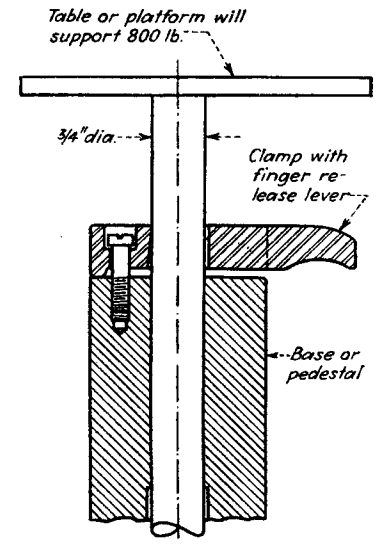




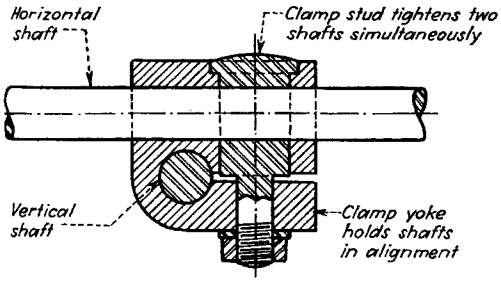
DOUBLE CLAMP FOR SPINDLE HEAD


Small handwheel rotates spur gear to adjust center
Sleeve with rack teeth
Center is journaled in bearings within sleeve
Large handwheel operates clamp blocks through long sleeve
Support
Spur gear
Shaft
Long sleeve
Blocks clamp sleeve when pushed together

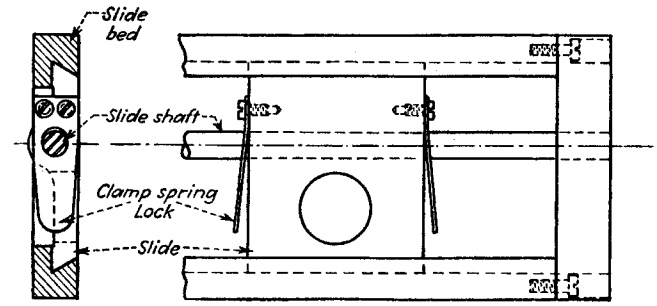
CENTER SUPPORT CLAMP



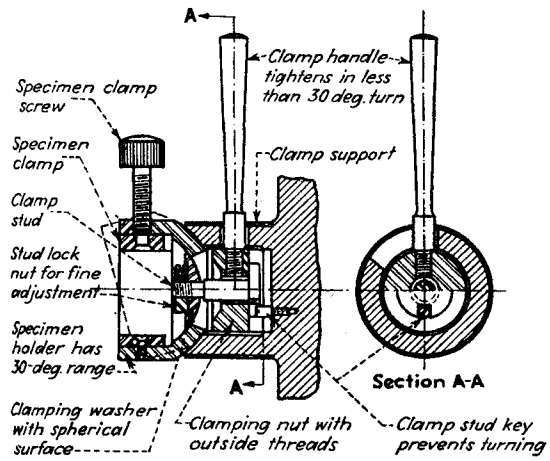
PEDESTAL CLAMP



RIGHT ANGLE CLAMP



SLIDE CLAMP



SPECIMEN HOLDER CLAMP

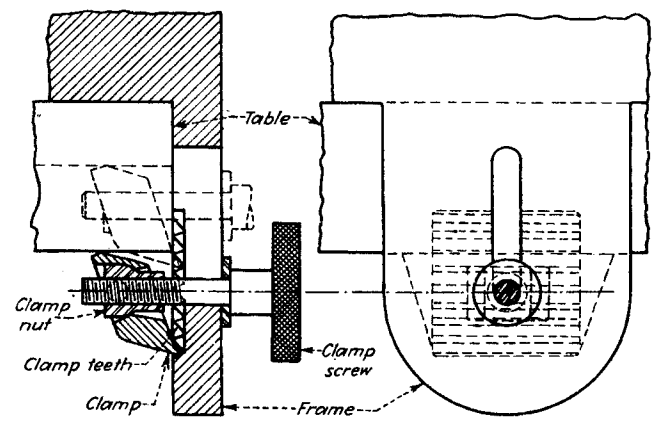


TABLE CLAMP

Clamping Devices for Aligning Adjustable Parts

Methods of clamping parts which must be readily movable are as numerous and as varied as the requirements. In many instances, a clamp of any design is satisfactory, provided it has sufficient strength to hold the parts immovable when tightened. However, it is sometimes necessary that the movable part be clamped to maintain accurate alignment with some fixed part. Examples of this latter-type are described and illustrated.

Louis Kasper

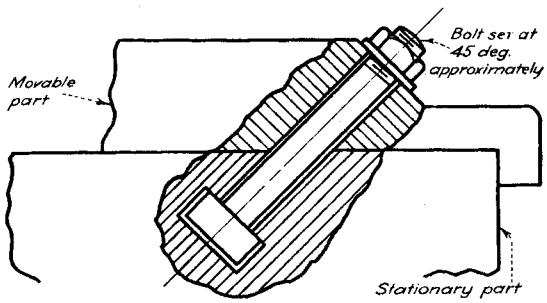


FIG. 1—When nut is tightened, the flange on the edge of the movable part is drawn against the machined edge of the stationary part. This method is effective, but removal of the clamped part may be difficult if it is heavy or unbalanced.

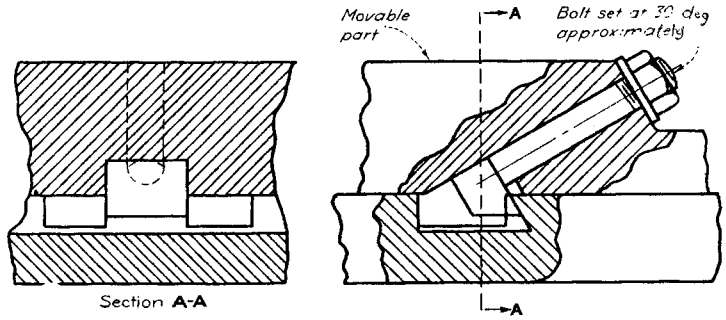
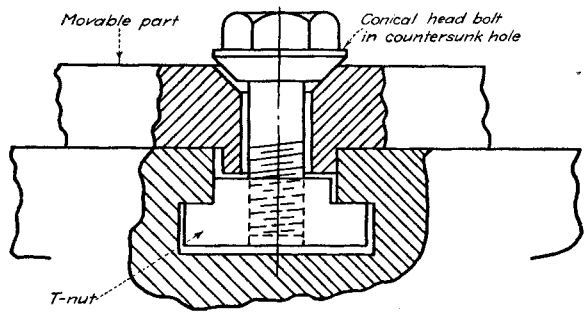


FIG. 2—Lower edge of the bolt head contacts the angular side of locating groove, causing the keys to be held tightly against the opposite side of the groove. This design permits easy removal of the clamped part, but is effective only if the working pressure is directly downward or in a direction against the perpendicular side of the slot.

FIG. 3—The movable part is held against one side of the groove while the T-nut is forced against the other side. Removal of the screw permits easy removal of the clamped part. Heavy pressure toward the side of the key out of contact with the slot may permit slight movement due to the springing of the screw.



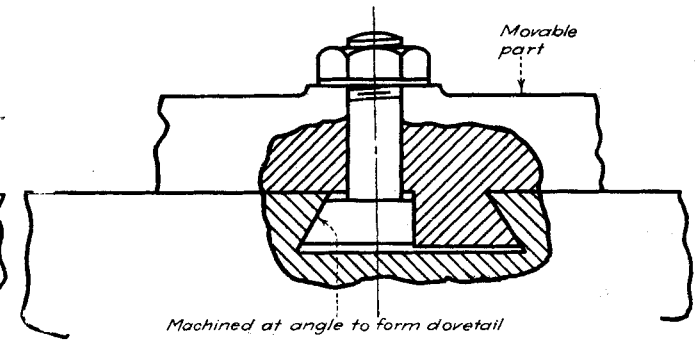


FIG. 4—One side of the bolt is machined at an angle to form a side of the dovetail, which tightens in the groove as the nut is drawn tight. Part must be slid entire length of slot for removal.

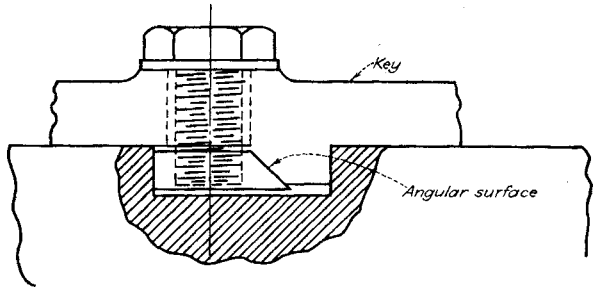
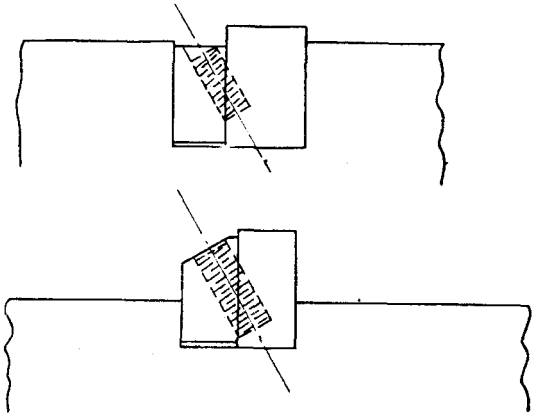


FIG. 5—The angular surface of the nut contacts the angular side of the key, and causes it to move outward against the side of the groove. This exerts a downward pull on the clamped part due to friction of nut against side of groove as nut is drawn upward by the screw.



FIGS. 6 and 7—These designs differ only in depth of the grooves. They cannot withstand heavy pressure in an upward direction but possess the advantage of being applicable to narrow grooves.

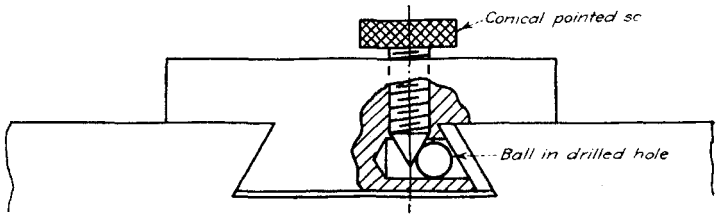


FIG. 8—Screw contact causes the ball to exert an outward pressure against the gib. The gib is loosely pinned to the movable part. This slide can be applied to broad surfaces where it would be impractical to apply adjusting screws through the stationary part.

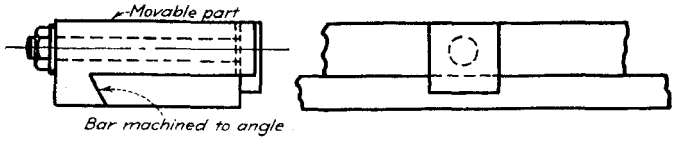


FIG. 10—One edge of a bar is machined at an angle which fits into mating surfaces on the movable part. When the bolt, which passes through the movable part, is drawn tight, the two parts are clamped firmly together.

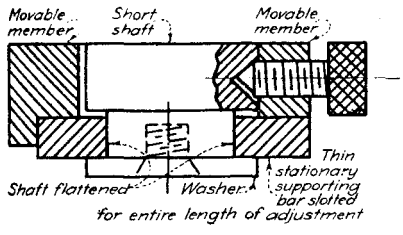


FIG. 9—The movable member is flanged on one side and carries a conical pointed screw on the other side. A short shaft passes through both members and carries a detent slightly out of alignment with the point of the screw. This shaft is flattened on opposite sides where it passes through the stationary member, to prevent its turning when the movable member is removed. A heavy washer is screwed to the under side of the shaft. When the knurled screw is turned inward, the shaft is drawn upward while the movable member is drawn downward and backward against the flange. The shaft is forced forward against the edge of the slot. The upper member may thus be moved and locked in any position. Withdrawing the point of the screw from the detent in the shaft permits removal of the upper member.

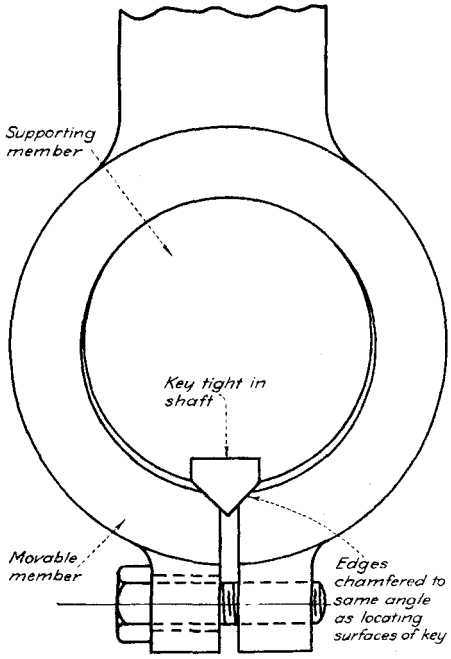


FIG. 11—As the screw is tightened, the chamfered edges of the cut tend to ride outward on the angular surfaces of the key. This draws the movable member tightly against the opposite side of the shaft.

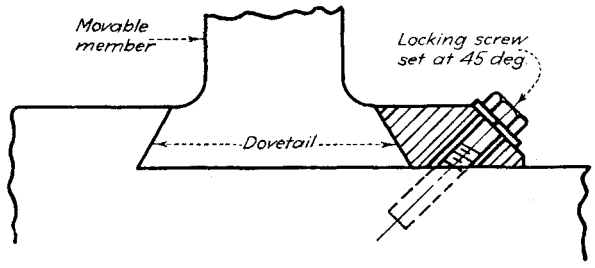
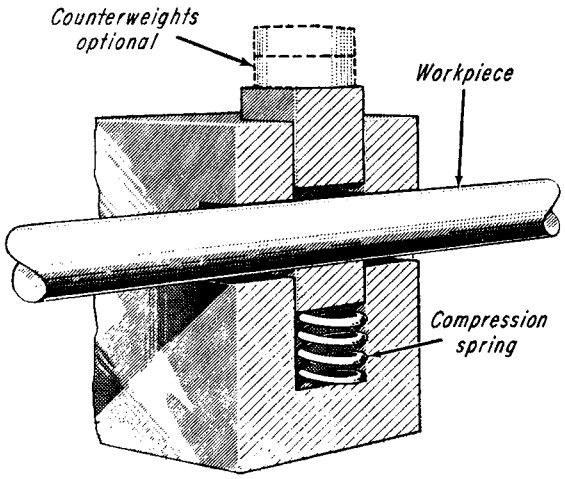


FIG. 12—As the screw is turned, it causes the movable side, which forms one side of the dovetail groove, to move until it clamps tightly on the movable member. The movable side should be as narrow as possible, because there is a tendency for this part to ride up on the angular surface of the clamped part.

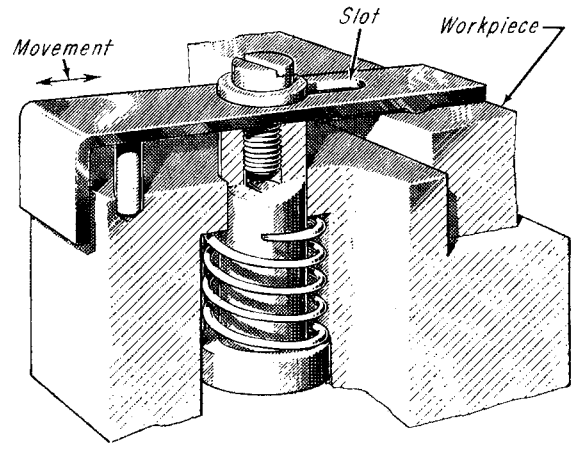
How Spring Clamps Hold Workpieces

Here's a review of ways in which spring clamp devices can help you get a grip on things.

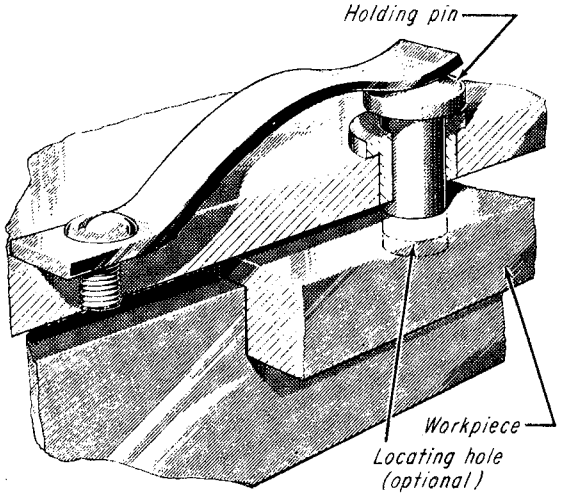
Federico Strasser



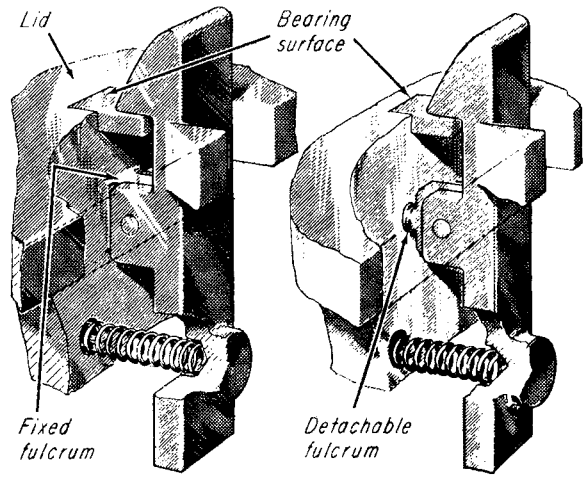
1 **RODS OF DIFFERENT SECTION** can be easily held by this device. Strength of grip can be varied if necessary.



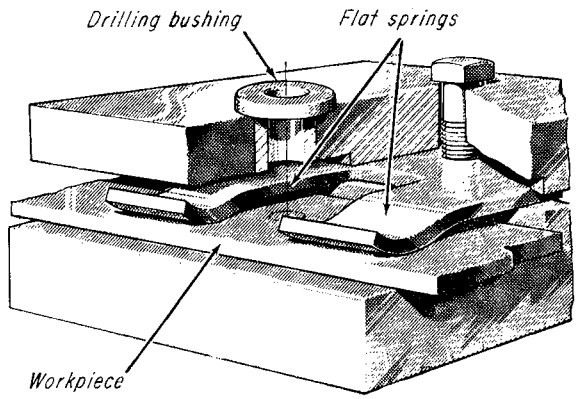
2 **SECOND-CLASS LEVER** gives low clamping forces for parts that are easily marked or require gentle handling.



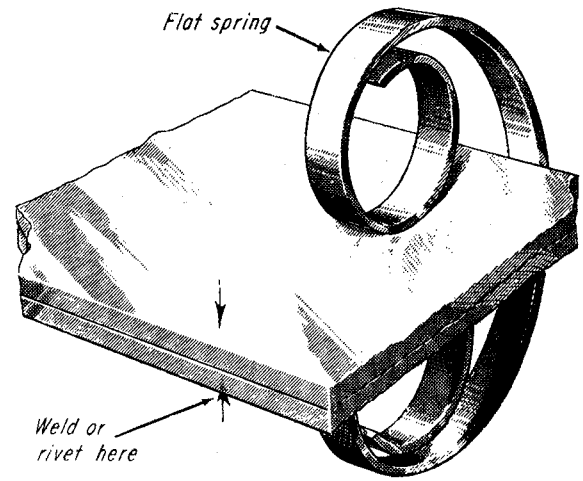
5 **FLAT SPRING ACTS THROUGH PIN** that holds the workpiece in the fixture. This device also positively locates parts.



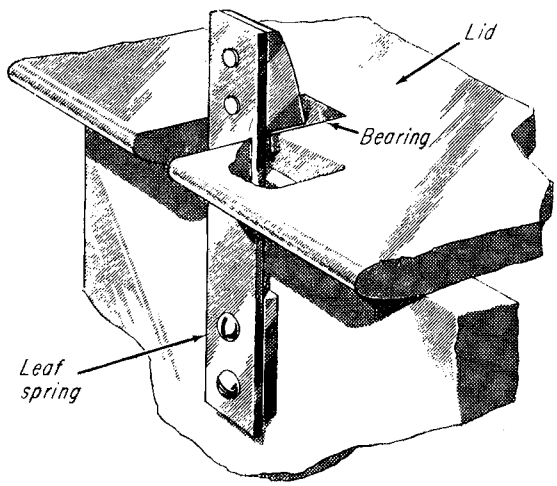
6 **COVER LATCH** is an ideal application for spring and notched lever. Make the fulcrum detachable for ease of repair.



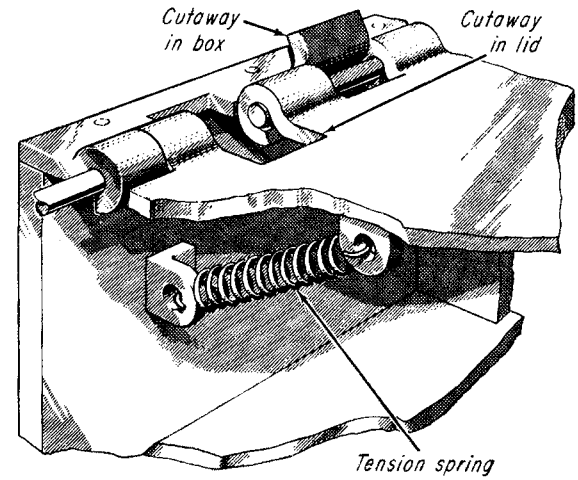
3 **FLAT WORKPIECES** of constant thickness are held with a couple of flat springs attached to the jig table.



4 **SIMPLE CLAMPING FIXTURE** is ideal for holding two flat pieces of material together for either welding or riveting.



7 **LEAF-SPRING** latch can be fashioned as shown, or the spring itself can be formed to provide its own latching notch.



8 **POSITIVE OPEN-OR-SHUT** lid relies upon a spring. Over-center spring action makes the lid a simple toggle.